



IMPERIAL INSTITUTE
OF
AGRICULTURAL RESEARCH, PUSA.

A SYNOPSIS OF SURGERY

ILLUSTRATED

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PREFACE TO THE TENTH EDITION

THE whole text has been carefully revised and brought up to date. The sections on the radium treatment of malignant disease, the surgery of the sympathetic nervous system, and the vaseline pack method (Winnett-Orr) of treating septic bone conditions, have been re-written. A new chapter giving in brief outline the principles of amputations has been added, and many minor additions and a few omissions have also been made.

E. W. H. G.

CLIFTON, *January*, 1933.

PREFACE TO THE FIRST EDITION

THE title of this small book describes its aim and scope. In recent years the tendency of all surgical literature to grow in bulk and diversity has of necessity compelled authors to enlarge their text-books more and more. Complete treatises on surgery occupy many volumes, and even the most concise require months for their perusal, so that a student often despairs of being able to revise his knowledge.

The present volume is an attempt to make an epitome of the salient facts in surgical practice, and to place these facts in such a manner that they may most easily and rapidly be referred to or revised. It has been compiled almost entirely from notes made by the author in preparing students for examinations.

It is of course obvious that the large works cannot be dispensed with ; but after a student has carefully read through a complete text-book, which ought to be done at the time he is actually engaged in ward and out-patient work, he may find this synopsis aid his memory in retaining a vast array of facts in an orderly manner.

The busy practitioner, who is expected to keep in practical touch with an ever-advancing science, has too often to allow the big books to go unread, whilst magazine articles are disconnected, discursive, and difficult for reference. It is thought that this synopsis may, by its methodical arrangement, prove of assistance by presenting the diagnosis and treatment of surgical conditions in a concise manner.

The special arrangement of headings, type, and indented margins enables the reader to see the scope of the subject at a glance, and to refer to any part of it at will. It may also offer some suggestions as to the arrangement of answers in a clear and succinct manner at examinations.

In the case of certain parts of the body where diagnosis is most difficult, e.g., the bones, joints, abdomen, and inguino-scrotal region, sections have been inserted dealing with the systematic examination of these parts.

Only the main points of operations are referred to, so that the principles which underlie each procedure may not be lost in a mass of details.

Anatomical and pathological facts are only inserted when they are essential to a comprehension of clinical signs and operative measures, but a summary of surface markings is added in the last chapter, which includes all those of importance.

In the main arrangement of the book, and in the sequence of the chapters, that most comprehensive and clear of all textbooks, "Rose and Carless", has been followed, and where special treatises or monographs are quoted, the reference is given in a foot-note.

E. W. H. G.

CLIFTON, *July*, 1908.

CONTENTS

	PAGE
PREFACE TO 10TH EDITION - - - - -	iii
PREFACE TO 1ST EDITION - - - - -	v
CHAPTER I.—INFLAMMATION AND SUPPURATION - - -	1
„ II.—SINUS, FISTULA, AND ULCERS - - -	10
„ III.—GANGRENE, FROSTBITES AND BURNS, SKIN- GRAFTING - - -	18
„ IV.—ACUTE SURGICAL INFECTIONS - - -	30
„ V.—GONORRHOEA - - -	44
„ VI.—SYPHILIS - - -	50
„ VII.—TUBERCULOSIS AND ACTINOMYCOSIS - - -	62
„ VIII.—TUMOURS AND CYSTS - - -	67
„ IX.—WOUNDS - - -	80
„ X.—ASEPSIS AND ANTISEPSIS - - -	87
„ XI.—SHOCK, SYNCOPE, AND COLLAPSE - - -	96
„ XII.—ANÆSTHESIA - - -	102
„ XIII.—INJURIES OF BLOOD-VESSELS - - -	121
„ XIV.—DISEASES OF ARTERIES - - -	134
„ XV.—DISEASES OF THE VEINS AND LYMPHATICS - - -	147
„ XVI.—AFFECTIONS OF THE SKIN - - -	156
„ XVII.—INJURIES AND DISEASES OF NERVES - - -	160
„ XVIII.—AFFECTIONS OF MUSCLES, TENDONS, SYNOVIAL SHEATHS, AND BURSEÆ - - -	178
„ XIX.—DEFORMITIES - - -	186
„ XX.—FRACTURES - - -	201
„ XXI.—DISEASES OF BONES - - -	233
„ XXII.—THE DIAGNOSIS OF SWELLINGS CONNECTED WITH BONES - - -	251
„ XXIII.—INJURIES OF JOINTS—SPRAINS AND DISLO- CATIONS - - -	254
„ XXIV.—DISEASES OF JOINTS - - -	269

	PAGE
CHAPTER XXV.—THE DIAGNOSIS OF AFFECTIONS OF THE JOINTS - - - -	299
„ XXVI.—INJURIES AND DISEASES OF THE SPINE - - -	302
„ XXVII.—HEAD INJURIES - - -	319
„ XXVIII.—DISEASES OF THE CRANIUM, BRAIN, AND MIDDLE EAR - - -	337
„ XXIX.—DISEASES OF THE LIPS AND JAWS - - -	353
„ XXX.—AFFECTIONS OF THE NOSE - - -	363
„ XXXI.—AFFECTIONS OF THE TONGUE - - -	369
„ XXXII.—AFFECTIONS OF SALIVARY GLANDS, TONSILS, PHARYNX, AND ŒSOPHAGUS - - -	377
„ XXXIII.—AFFECTIONS OF THE NECK - - -	384
„ XXXIV.—DISEASES OF THE AIR-PASSAGES AND CHEST - - -	395
„ XXXV.—DISEASES OF THE BREAST - - -	406
„ XXXVI.—INJURIES OF THE ABDOMEN. PERITONITIS - - -	415
„ XXXVII.—APPENDICITIS - - - -	427
„ XXXVIII.—INJURIES AND DISEASES OF THE STOMACH - - -	435
„ XXXIX.—INTESTINAL OBSTRUCTION - - -	456
„ XL.—HERNIA - - - -	479
„ XLI.—DISEASES OF THE COLON - - -	494
„ XLII.—DISEASES OF THE RECTUM AND ANUS - - -	512
„ XLIII.—AFFECTIONS OF THE LIVER AND BILE-DUCTS - - -	524
„ XLIV.—AFFECTIONS OF THE PANCREAS AND SPLEEN - - -	540
„ XLV.—AFFECTIONS OF THE KIDNEYS AND URETERS - - -	547
„ XLVI.—THE DIAGNOSIS OF ABDOMINAL DISEASE - - -	579
„ XLVII.—AFFECTIONS OF THE BLADDER - - -	589
„ XLVIII.—DISEASES OF THE PROSTATE - - -	600
„ XLIX.—AFFECTIONS OF THE URETHRA - - -	608
„ L.—DISEASES OF THE MALE GENITAL ORGANS - - -	615
„ LI.—DIAGNOSIS OF SWELLINGS IN THE INGUINO-SCROTAL REGION - - -	630
„ LII.—AMPUTATIONS - - - -	634
„ LIII.—SURFACE MARKINGS - - -	642
INDEX - - - -	669

SYNOPSIS OF SURGERY

CHAPTER I.

INFLAMMATION AND SUPPURATION.

INFLAMMATION.

Definition.—The changes that follow injury of living tissues.

Causes.—(1) Mechanical injuries; (2) Bacterial invasion; (3) Thermal injuries—heat or cold; (4) Chemical injuries; (5) Electrical injuries—high-tension currents—X rays.

Histological Changes.—

1. VASCULAR CHANGES.—

HYPERÆMIA.—The small vessels dilate—The blood-stream slows after momentary acceleration.

STASIS.—The blood-stream comes to a standstill—The blood clots in the vessels.

EXUDATION.—The white cells, which have been hugging the vascular wall, now creep through it—The red cells escape passively from the vessel—The serum of the blood oozes out from the vessel.

2. TISSUE CHANGES.—Vary with the nature and virulence of the infective agent, with the resistance of the individual, and with the local circulatory conditions.

May be one of three processes, viz. :—

a. PROLIFERATION.—Results from mild or chronic infections
The connective and endothelial cells multiply by division.
Fresh connective tissue is formed thereby.
Produces thickening, fibrosis, or sclerosis.

b. GRANULATION.—Produced by trauma, e.g., open wounds, mild infection, or when virulent infection is at an end.
Exuded lymphocytes form a mass of 'small round cells', which invades and replaces the tissues.

c. DESTRUCTION.—

i. Colliquative necrosis. The result of non-bacterial injury, especially burns.
Excessive fluid exudation, with separation and disintegration of cells, forms a blister.

ii. Coagulation necrosis. The result of infection by pyogenic organisms.

The exuded serum containing bacteria and toxins coagulates round the tissue cells. Many of the tissue cells and leucocytes are killed by the toxins.

Inflammation—Tissue Changes, *continued*.

Ends in one of four ways:—

1. Catarrh.—The dead cells are thrown off from a free mucous surface, but only the superficial parts are lost.
2. Ulceration.—The dead cells are thrown off from a free surface in such numbers as to leave an area devoid of skin or mucous membrane.
3. Suppuration.—The coagulated tissue is peptonized and liquefied by the bacteria and leucocytes. Polynuclear leucocytes destroy and are destroyed by the bacteria.
4. Sloughing or gangrene.—The tissue dies *en masse* and forms a dead slough.

Local Results.—

1. RESOLUTION without any permanent effect; only possible when the process has stopped short of thrombosis.
The circulation is resumed.
The exuded cells and serum are absorbed.
2. ORGANIZATION of the inflammatory products.
Only occurs when the infective agent is mild.
The granulation tissue or 'small round cells' and the connective-tissue cells form fibroblasts, and these form new connective tissue.
New vessels are formed by a budding out from old vessels.
3. DESTRUCTION of the tissues, usually followed by repair by granulation tissue.
ULCER.—The loss of tissue on a free surface.
ABSCESS.—The liquefied dead tissues below the surface.
SLOUGH.—A piece of tissue which has been killed *en masse*, but not liquefied.
GANGRENE.—The death of tissues in massive quantity. A term usually applied to the death of an organ or part of a limb.
N.B.—Ulceration, sloughing, or gangrene may be caused by other things besides inflammatory infections.

Signs.—

1. Heat
2. Redness
3. Swelling, caused by hyperæmia and exudation.
4. Pain, increased by pressure or movement.
5. Loss of function.

Symptoms.—Febrile symptoms are nearly always present, but they are due to an infection, or, in a traumatic case, to the toxins produced by the dead tissues. They vary according to the nature of the infection and resistance.

Treatment of Acute Inflammation.—**LOCAL.—**

Remove the exciting cause if possible. Rest the inflamed part. Cold applications to prevent hyperæmia.

Only suitable in non-infective cases, e.g., sprained joints.

ENCOURAGEMENT OF HYPERÆMIA to hasten natural process.

Hot fomentations.

PASSIVE HYPERÆMIA in acute inflammation is obtained in three ways: (1) By an elastic bandage tied round a part at a distance from the inflamed focus. This should be tight enough to obstruct the venous return without affecting the arterial pulse, and should relieve, not increase, the pain. It is left on for twenty hours out of twenty-four at first, and for shorter periods later. (2) By cupping-glasses, which are exhausted by an attached rubber ball or suction pump. These are placed over the affected focus when situated on the trunk. They are applied for about one hour a day, the suction being released every five minutes for one minute. (3) Large glass receptacles into which the whole or part of a limb can be placed and the air partly exhausted. In all cases the treatment does not obviate the necessity for early incisions directly suppuration has occurred, but these incisions should be only short, small openings, and it is not necessary to pack them.

DEPLETION OF BLOOD: Leeches—Scarification—Multiple incisions.

CONSTITUTIONAL.—

Rest in bed. Low diet.

Antitoxic sera to neutralize the toxins.

Antibacterial sera to kill the bacteria.

Inoculation with modified toxins to increase opsonins.

Treatment of Chronic Inflammation.—

Remove the cause if possible. Rest.

ACTIVE HYPERÆMIA: Massage—Hot-air treatment.

COUNTER-IRRITATION: Blister—Seton—Actual cautery—Iodine or mercurial applications.

PRESSURE: Bandaging—Elastic pressure—Scott's dressing—Unna's paste.

SUPPURATION.

Definition.—The molecular necrosis and liquefaction of living tissues.

Varieties.—

RATE OF DEVELOPMENT.—Acute or chronic.

NATURE OF INFECTION.—Simple pyogenic infection.

Specific infection with the bacteria of a specific fever, e.g., typhoid, tubercle.

4 * INFLAMMATION AND SUPPURATION

Suppuration—Varieties, *continued*.

SITUATION.—

MUCOUS MEMBRANE: Catarrh, e.g., acute otitis media.

SEROUS MEMBRANE: Purulent serositis, e.g., peritonitis or empyema.

FREE SURFACES: Ulceration—'Inflamed ulcers.'

BELOW SURFACE: Abscess—localized suppuration; Cellulitis—diffuse suppuration.

Cause.—Infection by bacteria:—

Through a wound.

Through the lymph or blood-stream.

Bacteria which cause suppuration (*see Fig. 1*).—

I.—SIMPLE PYOGENIC BACTERIA, i.e., those which produce suppuration without causing any specific fever.

1. STAPHYLOCOCCUS PYOGENES: Aureus, Albus, and Citreus.

Grow readily in culture media.

Form luxuriant patches in a few days.

Gram-positive.

Liquefy gelatin.

Powerful tryptic action.

Form clusters of minute dots in the growth or tissues.

Are the commonest cause of suppuration.

The aureus is the most virulent. The albus least virulent.

No antitoxin.

Useful vaccine.

Common cause of:—

Boils, superficial abscesses; Carbuncles (here a slough is produced—*see below*)—Peritonitis—Empyema—Osteomyelitis and arthritis.

2. STREPTOCOCCUS PYOGENES.—

Forms chains of minute dots.

Grows slowly outside the body.

Forms minute dot-like colonies.

Gram-positive.

Survives desiccation.

Hæmolytic and non-hæmolytic.

Does not liquefy gelatin.

Antiserum is used.

Causes virulent suppuration: Erysipelas—Cellulitis—Acute arthritis—Peritonitis—Empyema—Septicæmia and pyæmia.

3. BACILLUS COLI COMMUNIS.—

Occurs in the healthy intestine.

Is a motile bacillus with flagella.

Grows readily in culture media.

Gram-negative.

Produces Indol—Free gas—Acid.

Gives rise to specific agglutinins.

Causes acute peritonitis—Cystitis—Any abdominal suppuration—Rarely abscesses elsewhere in bones, joints, or soft parts.

4. **BACILLUS PYOCYANEUS.**—

Motile with flagellum.

Grows in wounds—Produces greeny-blue pus.

Gram-negative.

When it occurs in a superficial wound its toxic action is only slight.

When very virulent, it may cause peritonitis, septicæmia, or pyæmia.

Especially found in long-standing sinuses of bone.

II.—**SPECIFIC PYOGENIC BACTERIA.**—Bacteria which produce a well-marked specific disease, and occasionally local suppuration.

1. **PNEUMOCOCCUS.**—

Stains by Gram's method.

Is a diplococcus. Usually encapsuled.

Grows outside the body with difficulty.

Is the ordinary cause of pneumonia.

Also causes :—

Empyema : common. Peritonitis, Arthritis, Osteomyelitis : rare.

2. **BACILLUS TYPHOSUS.**—

Does not stain by Gram's method.

Forms specific agglutinins.

Does not produce indol or gas.

A multiflagellate bacillus.

Is the ordinary cause of enteric fever.

May cause :—

Bone suppurations—periostitis. Suppuration in the gall-bladder. Local peritonitis.

3. **GONOCOCCUS** (*see below*).

4. **TUBERCLE.**

Minute Anatomy of an Abscess.—

I.—IN THE EARLY STAGES it shows all the signs of acute inflammation, ending in coagulation necrosis.

II.—IN THE FULLY MATURED ABSCESS the central portion has become liquid pus.

The wall from without inwards consists of four zones :—

1. **HYPERÆMIA** and exudation.

2. **THROMBOSIS** with round-celled infiltration.

3. '**SMALL ROUND CELLS**' with many bacteria.

4. Central collection of Pus.

III.—IN THE HEALING ABSCESS a zone of fibrosis intervenes between the granulation tissue and the healthy tissue.

The innermost layer consists of granulation tissue, i.e., small round-celled tissue permeated by new blood-vessels.

Bacteria are practically absent, or dead.

Nature of Pus (*see Fig. 2*).—Fluid of sp. gr. 1030.

Contains 85 % water—Opaque white or yellow colour—Alkaline in reaction.

The liquid portion consists of a solution of peptones.

The solid portion consists of: Dead polynuclear leucocytes—Living leucocytes—Bacteria—Débris of partially digested tissues.

Signs and Symptoms of Acute Suppuration.—

SIGNS OF ACUTE INFLAMMATION, and especially :—

FLUCTUATION—showing the fluidity of contents.

EDEMA of the skin—of great value in deep suppuration.

HARD BRAWNY TEXTURE.

PAIN becoming distinctly THROBBING.

GENERAL SIGNS are those of a bacterial infection, and especially :

RIGOR or shivering fit, with rapid rise of temperature.

LEUCOCYTOSIS. Leucocytes increase from 5,000 to anything up to 100,000 per c.mm.

Absent in severe fatal infections.

It indicates local infection well resisted.

Treatment of Acute Suppuration.—

1. IN EARLY STAGES when suppuration is doubtful, treat as for acute inflammation.

2. WHEN PUS IS CLEARLY INDICATED.—

Open freely from the surface.

Open all secondary loculi into the main cavity.

Make the opening in the most dependent position.

Make as many openings as are necessary to drain the cavity freely.

Swab out the pus or irrigate with antiseptics.

Do not scrape the wall, for fear of infecting fresh tissues.

Put on an antiseptic dressing. Drain with tubes or gauze.

Continue fomentations or passive hyperæmia.

Chronic Abscess.—

DEFINITION.—A collection of pus without the signs of inflammation. Usually of very slow development.

PATHOLOGY.—

TUBERCLE is the cause in the vast majority of cases.

PYOGENIC COCCI may give rise to an abscess, and then the organisms die or become latent, and the abscess remains cold and chronic. Especially in connection with bones.

ANATOMY.—

May be connected with any tuberculous focus.

Commonly connected with BONE, JOINT, OR LYMPHATIC DISEASE.

Ceases to be a chronic abscess when it is infected with active pyogenic organisms. Hence the predilection for sites removed from skin or mucous membrane.

GROWTH : Slowly spreads along lines of areolar tissue. Guided by fascial planes, or the sheaths of blood-vessels.

WALL : Usually thick and well defined. Lined by a layer of soft granulations which forms 'the pyogenic membrane'. These contain tubercle bacilli and giant-cell systems which form caseous masses, in the tuberculous cases. A dense layer of fibro-cicatricial tissue lies outside the granulations.

CONTENTS : Pus of a special character (*see Fig. 3*). Curdy and fatty débris. Very few cells, and these degenerate. Occasionally cholesterol crystals. No bacteria except tubercle, and those very scanty. Pus is usually infective to animals.

COMMON EXAMPLES of Chronic Tuberculous Abscesses.—

Psoas Abscess.—Caused by dorsi-lumbar tuberculous disease.

Spreads beneath the internal arcuate ligament. Guided by the sheath of the psoas muscle. Forms a fluctuating swelling above Poupart's ligament on the outer side of vessels. Dips beneath the femoral vessels, and enters the thigh behind and on the inner side. May continue down the thigh to the knee.

Aspirate over the fluctuating areas. Usually :—

- (a) Above the outer half of Poupart's ligament, or
- (b) Below the inner half of Poupart's ligament, or
- (c) In the loin through the quadratus lumborum.

Occasionally at two of these places.

ILIAC ABSCESS.—Arises from disease of the ilium, sacro-iliac joint, or of the hip-joint through the acetabulum. Forms a fluctuating swelling in the iliac fossa. Aspirate or open above outer half of Poupart's ligament.

LUMBAR ABSCESS.—Usually caused by disease of the lumbar vertebrae. Is directed by the dorsal branches of the lumbar arteries. Tracks beneath the psoas and on inner side of quadratus. Points on outer side of the erector spinæ.

Aspirate or open by a vertical incision over the outer border of erector spinæ.

COSTAL OR INTERCOSTAL ABSCESS.—Caused by disease of the ribs or of the dorsal or cervical vertebrae.

Aspirate or open over the fluctuating swelling.

CHRONIC RETROPHARYNGEAL ABSCESS.—Caused by disease of the upper cervical vertebrae.

Lies behind the prevertebral fascia.

Open behind the sternomastoid.

TERMINATION.—

1. **RECOVERY** by absorption of the abscess contents.

The contents become caseous, cretified, or are absorbed.

A fibrous scar remains.

Seldom happens except in very small abscesses.

2. **BURSTING** externally or into a mucous canal.

Rapidly infected with pyogenic organisms.

Incurable or fatal sepsis results.

Chronic Abscess—Terminations, *continued*.

3. DEATH FROM SEPTIC ABSORPTION after pyogenic infection. Usually of a hectic type.
4. DEATH FROM AMYLOID OR LARDACEOUS DISEASE after pyogenic infection. Waxy degeneration occurs in the vessels and viscera, viz. : in the arterioles and capillaries ; in the liver, spleen, kidneys, and intestines.
Reactions of the waxy substance.—
Iodine—turns brown. Sulphuric acid after iodine—inky blue. Methyl violet—red.
Symptoms and signs.—
Enlargement of the liver and spleen. Albuminuria, with great increase of amount of urine, with casts. Diarrhœa.
Condition can be arrested if the radical removal of the suppurating focus is done early.
5. RECURRENCE after spontaneous absorption or after operation is very common.

SYMPTOMS AND SIGNS.—

- Swelling of slow appearance.
Absence of heat, redness, tenderness, or raised temperature.
Fluctuation is well marked unless the abscess is very deep.
Other symptoms and signs are merely those of the cause of the abscess, e.g., signs of caries of the spine or of sacro-iliac disease.
Sepsis, acute or chronic, only develops after pyogenic infection, i.e., after the abscess has opened in the majority of cases.
Amyloid disease may also occur.

TREATMENT.—

- Excision.—If anatomically possible—e.g., in lymph glands, or rarely in an early rib abscess.
Aspiration.—This should be the routine method in most cases. A large needle is thrust into the skin after the latter has been pulled down, so as to make a valvular opening. Evacuate by simple pressure or an aspirator.
INJECTION OF LIQUEFYING SOLUTIONS.—If the contents are too thick to run through a needle, a fluid—e.g., thymol 1 part, camphor 2 parts, and ether 3 parts—is injected, and then the aspiration is repeated in a week.
INJECTION OF ANTISEPTICS.—After aspiration an emulsion of iodoform (10 per cent in glycerin or ether) is injected.
INCISION AND SCRAPING.—Abscess is opened through a small valvular incision made in healthy skin. If the skin is unhealthy, thin, or red, it should be excised. The pus is evacuated. Wall of abscess is scraped with a sharp spoon. Any loose fragments of bone are removed. Incision is carefully sutured.
This method is especially indicated where there are accessible sequestra.

EVACUATION AND PACKING.—As in the last method, but operation is completed by packing with gauze smeared with bismuth iodoform paraffin paste (B.I.P.P.) after swabbing out with alcohol. Place deep sutures but do not tie. Remove pack in one or two days and tie sutures.

Especially suitable for large abscesses where the whole cavity is accessible.

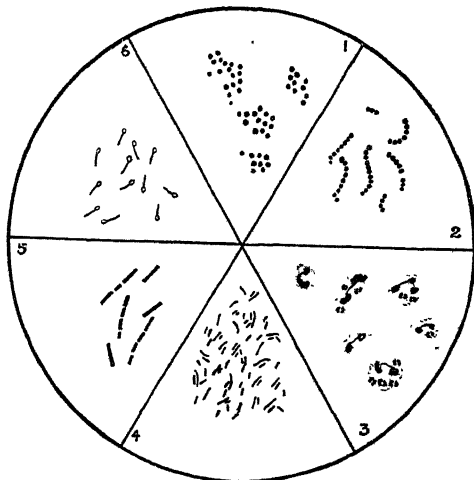


Fig. 1.—Various forms of bacteria.

1, Staphylococci; 2, Streptococci; 3, Gonococci; 4, *B. coli*; 5, *B. anthracis*; 6, *B. tetani*.

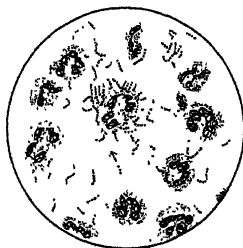


Fig. 2.—Pus from acute abscess, showing cocci and leucocytes.

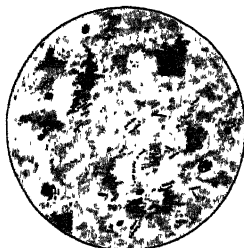


Fig. 3.—Pus from chronic abscess, showing tubercle bacilli. All cells are disintegrated.

CHAPTER II.

SINUS, FISTULA, AND ULCERS.

Definition of Sinus and Fistula.—A Sinus is a track lined by granulations, leading from a free surface into the depths of the tissues. A Fistula is a track which opens at both ends on to an external or internal cutaneous or mucous surface.

Structure.—An outer layer of fibrous tissue, which in old cases becomes very thick and dense like cartilage. An inner layer of granulations, usually infected by bacteria.

Causes.—Abscess—Penetrating wounds.

CAUSES OF NON-CLOSURE of sinuses and fistulae.

Dead septic body in the sinus, e.g., necrosed bone.

Foreign body which is septic, e.g., ligature.

Insufficient opening of a deep cavity.

Inability of a deep cavity to collapse, e.g., empyema.

Tuberculous or septic infection of the walls of the sinus.

Constant passage of septic discharges, e.g., faecal or urinary fistula.

Massive growth of fibrous tissue like cartilage round the sinus.

Growth of epithelium down the sinus.

EXAMINATION OF COMPLICATED SINUSES.—

Inject the sinus with a mixture of bismuth carbonate and vaseline (*see below*) and photograph with the X rays.

Treatment of Sinus or Fistula.—

Lay it freely open.

Find and if possible remove any necrosed bone or other septic bodies.

Provide efficient drainage or close altogether the cavity to which it leads.

Scrape away all granulations from its walls.

Swab with pure carbolic in very septic cases.

Excise the whole track where possible when it is very dense.

Pack the cavity left and allow to heal by granulation.

SPECIAL TREATMENT OF FISTULA.—

Special plastic operations to close the inner opening, or other special operations.

TREATMENT OF CHRONIC SINUSES, especially those left after opening tuberculous abscesses.—

Cleanse the sinus with 90 % alcohol.

Inject first with a soft bismuth mixture (bismuth carbonate 1 part to vaseline 2 parts).

Repeat this once a week.

Later, when the discharge lessens, use a harder bismuth mixture; e.g., bismuth carbonate 30 parts, white wax 5 parts, paraffin (melting point 49° C.) 5 parts, vaseline 60 parts.

The injections can be made at longer and longer intervals if the case is favourable.

The bismuth mixtures are sterilized by placing them in a vessel in water and boiling the latter for an hour. They are injected whilst warm.

There is some reason to think that the bismuth owes its activity in this method of treatment to its capacity for acting as a radio-active substance after exposure to the X rays. Therefore after each injection the X rays should be applied for about fifteen minutes about once a week.

Definition of Ulcer and Ulceration.—An ulcer is a superficial loss of tissue involving a part of the skin or mucous membrane. Ulceration is a molecular necrosis of superficial tissue leading to a loss of substance.

Classification by their cause.—

1. **TRAUMATIC.**—Caused by injury.

Mechanical: the results of wounds. Chemical: the results of caustics. Thermal: the results of burns. Electrical: the results of electric currents or X rays.

2. **PYOGENIC.**—Caused by inflammation due to the ordinary pyogenic cocci.

3. **CONGESTIVE.**—A reduced vitality due to deficient circulation is the chief cause, but traumatism and pyogenic infection always play their part.

4. **NECROTIC.**—Due to loss of tissue by sloughing. This may be septic or aseptic.

5. **TROPHIC.**—Due chiefly to nerve lesions causing anæsthesia.

6. **SPECIFIC.**—Due to special bacterial diseases, e.g., tubercle, syphilis, anthrax.

7. **MALIGNANT.**—Due to pressure of a malignant growth, or to a replacement of skin or mucous membrane by new growth, which then breaks down by ulceration.

General Features of Ulcers.—Points to be noticed :—

1. **SURFACE.**—

Usually depressed below the healthy surface.

Elevated above the surrounding surface in the following :—

Ulcer with exuberant granulations; malignant or any fungating growth.

Ulcers—General Features—Surface, *continued*.

Sloughy, smooth, granulating, or fungating, according to the stage of ulceration.

Granulations may be vascular, e.g., in healing ulcers; œdematous, e.g., in tuberculous; fibrous, non-vascular, in syphilitic.

2. EDGE.—

Eroded and dark red or covered with slough: when the ulceration is actively spreading.

Rounded, smooth, thick edge: when the ulcer is stationary.

Shelving, with white, blue, and red zones: healing.

Thick, infiltrated, raised, or everted: new growth.

Clean cut, 'punched out': especially in syphilitic tertiary ulcers.

Gyrate or circinate, i.e., made up of parts of several smaller circles: usually tertiary syphilis.

Undermined, when an ulcer follows a subcutaneous growth, abscess, or gumma: often seen in tubercle, sarcoma, syphilis.

Surrounded by mass of hard epidermis: perforating ulcer.

3. RELATION TO STRUCTURES BENEATH.—

Movable over deep structure: healthy and healing.

Fixed to deep structure: chronic stationary.

Fixed to deep tumour: new growth.

Penetrating deeply into bones and joints: perforating ulcer.

4. DISCHARGE.—

Purulent and free, containing active bacteria: in spreading cases.

Scanty and serous: in healing cases.

Bleeds readily and copiously: malignant.

Bleeds moderately: healthy granulations.

Does not bleed though granulating: syphilis.

Leaves chalky deposit: gouty.

May contain special structures, e.g., actinomycosis granules, epitheliomatous cells, etc.

5. CONDITION OF THE SURROUNDING TISSUES.—

Swollen, œdematous, congested: congestive ulcers.

Inflamed: pyogenic ulcers.

Quite healthy, with abrupt transition: tertiary syphilis.

Deep induration: malignant.

6. POSITION.—

Traumatic ulcers may be anywhere, most commonly on exposed situations.

Congestive ulcers: lower half of leg.

Tuberculous ulcers: in neck, groins, or axillæ, i.e., over glands or over joints. May occur anywhere.

Lupus: face (nose, mouth, ears), fingers or toes.

Syphilis (tertiary): may be anywhere, but especially near the knees (*Fig. 4*), buttocks, outer side of thighs. Also in face, nose, and mouth.

- Malignant: anywhere, but most commonly in mouth and tongue, breast, external genitals.
- Trophic or Perforating: Site of any old scar or ulcer. Beneath the sole of the foot, usually under the great toe.
7. SHAPE.—
Simple congestive ulcers tend to be round or oval.
Tertiary specific ulcers may be circinate, i.e., formed by the coalescence of several ulcers; or islands of skin may be present in the midst of an ulcer from the same cause.
8. NUMBER.—
Multiple ulcers, especially if widely scattered, indicate some constitutional infection, e.g., tubercle, secondary syphilis.
Multiple ulcers all on the same part indicate some local infection by pyogenic bacteria.
Single large ulcers are either of mechanical, congestive, malignant, or tertiary syphilitic origin.
9. RATE OF PROGRESS.—
Short history: rapid healing is found in most simple pyogenic ulcers.
Extreme chronicity: especially in congestive ulcers, also in rodent ulcers.
Steady growth: malignant ulcers.
10. MICROSCOPICAL CHARACTER of the growing edge.—
Shows malignant or tuberculous character.

Stages of Simple Ulceration.—

- 1.—EXTENSION.—The inflamed ulcer.
STRUCTURE.—Is that of the wall of an acute abscess.
CHARACTERS.—
Surface: Covered with sloughs or lymph. No granulations.
Discharge: Copious, thin, offensive.
Margins: Acutely inflamed, with well-defined edge.
Base: Thick and adherent.
TREATMENT.—Rest—Fomentations—Passive hyperæmia.
- II.—STATIONARY OR CHRONIC STAGE.—The stage between tissue necrosis and tissue formation, i.e., between sloughing and granulation. Theoretically every ulcer undergoes this stage, but only in chronic ulcers is it well marked. In healthy ulcers tissue regeneration begins directly necrosis is at an end.
STRUCTURE.—The inflammatory zones of hyperæmia and exudation become converted into fibro-cicatrical layers.
The surface is covered by a layer of small round cells, not sufficiently vascularized to form granulations.
CHARACTERS.—
Surface: Smooth, glazed, and shiny.
Discharge: Scanty and serous.

Ulcers—Chronic Stage—Characters, *continued*.

Margins : May be congested, but are not inflamed.

Edges : Rounded, hard, and elevated.

Base : Often adherent to underlying structures, e.g., the periosteum.

Skin around is very congested, and often pigmented, with marked œdema in 'congestive' cases (*Fig. 5*).

CAUSES OF CHRONICITY, i.e., of non-healing of an ulcer.—

1. Defective circulation : In lower parts of legs—In those who stand all day—In old people.
2. Venous obstruction : Varicose veins—After venous thrombosis, e.g., 'white leg'—Pregnancy.
3. Fixation of the ulcer to underlying bone or fascia : Prevents the edges being drawn together—Prevents the base being drawn up to the edges—Prevents the proper vascularization of the base of the ulcer necessary for the formation of granulations.
4. Constitutional conditions : Bright's disease—Gout—Diabetes, etc.
5. Continued irritation : When an ulcer is left dirty and without any dressing.
6. Pressure of œdema. This causes the vessels in the neighbourhood to be occluded, and produces an extension of the ulcer.

VARIETIES OF CHRONIC SIMPLE ULCERS.—

1. Varicose ulcer. Due to congestion of varicose veins of the leg.
2. Congestive ulcer. Due to congestion of the leg from weak circulation, long standing, etc.
3. Eczematous ulcer. Superficial, not deeper than the dermis. Copious discharge.
4. Irritable ulcer. Over the ankle. Small but very painful. Exposes terminal nerve filaments.
5. Ulcer after a burn or other traumatism. When the whole skin thickness is destroyed, and when a large ulcer overlies a dense fascia or bone. Adhesions of the base to this prevent cicatricial contraction.

COMPLICATIONS OF CHRONIC SIMPLE ULCERS.—

ŒDEMA of the parts below, from the pressure of cicatricial contraction on the blood- and lymph-vessels.

PERIOSTITIS of the underlying bone, forming a large periosteal node.

EPITHELIOMA : The edges become thickened, everted, or warty—A very slow growing form of cancer, which may remain for years—Lymphatic extension is very slow, because the lymph channels have been destroyed.

TREATMENT OF CHRONIC SIMPLE ULCERS.—

POSTURE : Rest, with elevation of the foot.

PRESSURE : Simple or elastic bandages—Starch bandages over dressings—Strapping.

UNNA'S PASTE is the most useful routine treatment, because it combines uniform pressure with the application of a stimulating medicament. It consists of zinc oxide 5 parts, gelatin 5 parts, glycerin 8 parts, boric acid 1 part, and water 6 parts. It is liquefied in a pot placed in hot water and painted over a layer of gauze wrapped round the limb and surrounded by a thin bandage soaked in the mixture. It is changed once a week. In the case of large foul ulcers a window may be cut in the dressings over the sore, and the ulcer dressed daily.

DRESSINGS.—

When the surface is foul: Charcoal or boracic fomentations.

For mere indolence: Metal, e.g., a piece of pewter cut to the size and shape of the ulcer—Metallic ointments, especially zinc—Resins, e.g., resin ointment—Oxygen, applied for half an hour daily.

Method: If ointments are used they should be spread on lint cut to the shape but rather smaller than the ulcer. All old ointment should be cleaned off daily with oil. The following ointment is very useful because of its power of stimulating epidermal growth: Scarlet red 1 part, ung. boracis 9 parts.

OPERATIVE TREATMENT.—

Multiple incisions in a longitudinal direction to relieve congestive oedema.

Undercutting the ulcer edges so as to free them from deep adhesions.

Tying prominent varicose veins above the ulcer.

Periarterial sympathectomy, either alone or in conjunction with skin grafting. Of particular use in congestive ulcers.

Skin grafting. Most useful in traumatic, e.g., burn ulcers.

Amputation: For old ulcers of large size with base fixed to the periosteum—Foul ulcers encircling more than half the circumference of the limb and producing great oedema of the parts below—For epithelioma.

III.—STAGE OF REPAIR.—

STRUCTURE.—

The floor is covered with small round cells grouped round new vascular loops, thus forming the granulations.

When the cavity is filled with granulations, the epidermis grows over them from the edge, and so covers the surface.

The granulation tissue becomes converted into fibrous tissue, the deeper layers undergoing this change first.

The contraction of this fibrous tissue is essential to the repair of all large or deep ulcers.

Ulcers—Stage of Repair, *continued*.

1. It draws the base up to the edges.
2. It draws the edges together.

CHARACTERS.—

Surface: Covered by red granulations.

Edge: Shelves gradually into the ulcer and is on the same level with the granulations. Shows a white, blue, and red margin.

White margin = heaped-up epidermis.

Blue zone = granulations seen through thin, transparent epidermis.

Red zone = granulations.

Base is free from the underlying tissues, i.e., movable over them.

Margins are free from inflammation or congestion.

TREATMENT OF A HEALING SIMPLE ULCER.—

Protection by simple dressing.

Prevent the granulations sprouting up above the skin margins by silver nitrate.

Trophic or Perforating Ulcer of the Foot.—

CAUSES.—

PREDISPOSING.—Diseases of the cord, e.g., tabes or syringomyelia; neuritis, whether diabetic, syphilitic, or alcoholic; peripheral nerve lesions causing anæsthesia.

EXCITING.—Pressure of a corn or an abrasion which is unnoticed and neglected because of the anæsthesia.

CHARACTERS.—The orifice is on the sole of the foot, usually under the ball of the great toe (*Fig. 6*). The margins are formed by heaped-up hard epithelium.

A long sinus leads into the deep tissue of the foot, usually involving carious bones and disorganized joints.

It may have acquired a second opening on the dorsum of the foot (hence the term perforating ulcer).

Probing is conspicuously painless.

TREATMENT.—Rest in bed. Freely opening up and scraping out the unhealthy tissues. Cutting away all the exuberant epidermis. Subsequent protection from pressure by suitable padding.

Amputation may be necessitated if many of the tarsal bones and joints are diseased.

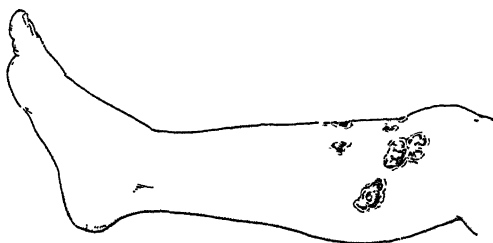


Fig. 4.—Syphilitic ulcer of leg.

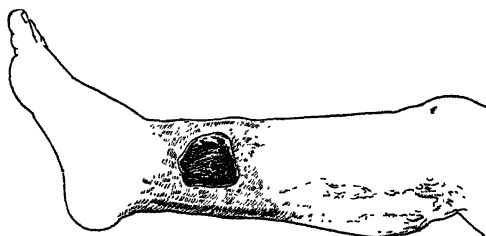


Fig. 5.—Chronic varicose ulcer of leg.



Fig. 6.—Perforating ulcer of foot.

CHAPTER III.

GANGRENE.

Definition.—Death of the tissues *en masse*.

Usually applied when the whole or a part of a limb or viscus is affected, with all the constituent tissues.

Signs.—(1) CESSATION OF CIRCULATION: Loss of pulse—Vessels do not empty on pressure. (2) LOSS OF HEAT. (3) LOSS OF SENSATION. (4) LOSS OF FUNCTION. (5) CHANGE OF COLOUR: Usually dark.

All these signs may be present and yet *recovery may take place* under the following conditions: Small area affected—Absence of the conditions favourable for sepsis—Good circulation in the neighbourhood.

In certain conditions the above signs indicate *inevitable gangrene* :—

When all the vessels going to a part are affected, i.e., when terminal vessels are concerned, e.g., terminal parts of a limb or testis with rotated cord.

When there are conditions favourable for sepsis, e.g., strangulated gut.

Further signs which prove that death has occurred: (6) MUMMIFICATION or drying of the tissues. (7) DECOMPOSITION of the tissues. (8) LINE OF ULCERATION between the dead and living tissues.

Varieties.—

1. DRY GANGRENE.—Death followed by *mummification* (Fig. 7).

a. PRIMARILY DRY.—Caused by blocking of the arteries whilst the veins remain patent, thus draining the tissues of fluid.

b. SECONDARILY DRY.—Caused by a loss of fluids from the tissues by evaporation in a case of moist gangrene which has remained aseptic.

The affected parts become hard, dry, and shrivelled.

Liberated hæmoglobin makes the tissues black.

Liberated fat causes some transparency of the skin, through which the deep tissues can be seen.

Sepsis is either absent, or unable in the absence of moisture to produce decomposition.

Terminates by an ulcerating line of demarcation which separates the mass, chiefly at the expense of the dead tissues.

It has little or no tendency to spread.

If extension occurs it is due to the original cause of the gangrene acting on tissues higher up.

Hence extension is rare, and when it occurs it is usually by leaps, not a gradual, steady process.

Associated with very slight febrile symptoms.

Usually is extremely painful.

Rarely causes death; but death may be hastened by the pain and want of sleep.

2. **MOIST GANGRENE.**—Gangrene of blood-filled tissues.

Veins as well as arteries are blocked, or congestion occurs simultaneously with arterial blocking.

a. It may become dry (very rarely) if asepsis be maintained until evaporation can take place.

b. It usually leads to rapid *putrefaction*. Hence in the vast majority of cases

Moist gangrene = death + putrefaction.

The affected parts are purple and swollen.

Superficial tissues are raised in blisters.

Deep tissues become emphysematous from the gases of decomposition.

Adjacent living tissues are much inflamed.

Terminates by a broad zone of ulceration which separates the mass at the expense of the living tissues.

It spreads steadily and swiftly by infection and thrombosis of adjacent living tissues.

Associated with marked toxæmic and febrile symptoms.

Pain is great, but is dulled by the toxæmia.

Causes death from septicæmia or secondary hæmorrhage.

The Tissue Changes that follow Gangrene.—These consist in a reaction between the dead and living tissues.

Three factors are concerned :—

1. The living tissues actively attack the dead tissues.

2. The dead tissues are removed partly by molecular and partly by massive necrosis.

3. Bacteria in the dead tissues attack and destroy some of the living tissues.

The actual result will depend on the relation between these three factors, and the dead tissues will suffer one of three fates :—

1. **ABSORPTION.**—

This really means the disintegration and removal by molecular necrosis of the dead tissue.

The living tissues are healthy and vascular.

Sepsis is absent or insignificant.

The amount of dead tissue is small.

The living tissue produces granulation tissue.

The granulations erode and digest the dead tissue.

2. **SEPARATION BY ASEPTIC ULCERATION.**—

The bulk of the dead tissue is large.

Or the vitality and circulation in the living tissues weak.

The granulating zone cannot penetrate far from its own base.

Tissue Changes following Gangrene, *continued*.

It merely corrodes the adjacent zone of dead tissue until it is completely separated.

The separated dead mass drops off or remains as a sequestrum.

3. SEPARATION BY SEPTIC ULCERATION.—

The dead tissues contain virulent bacteria.

Acute septic inflammation is caused in the living tissues thereby.

A zone of living tissue undergoes molecular necrosis, i.e., it suppurates.

Thus the line of separation between living and dead tissues forms at the expense of the living.

The final demarcation of the living tissue by a granulating zone is distinctly higher up than that of the original gangrene.

The process is one of acute suppuration.

Varieties of Gangrene in relation to its Cause.—

I.—SYMPTOMATIC.—Gangrene caused by some vascular or constitutional condition.

- (1) Embolic. (2) Senile. (3) Thrombotic. (4) Puerperal. (5) Diabetic (6) Raynaud's. (7) Thrombo-angitis obliterans. (8) Ergot.

II.—TRAUMATIC.—

- (1) Direct: when an injury kills the part injured. (2) Indirect: when an injury kills a part at a distance from the injury by damage of main vessels.

III.—THERMAL.—A variety of direct traumatic gangrene.

- (1) Burns. (2) Frost-bite.

IV.—INFECTIVE.—Gangrene resulting from septic inflammation.

- (1) Acute inflammatory gangrene. (2) Necrosis of bone. (3) Cancrum oris. (4) Carbuncle. (5) Gas gangrene.

Embolic Gangrene.—

EMBOLUS is dislodged from diseased cardiac valves. Or from a dilated left ventricle. Or from an atheromatous plate.

PREDISPOSING CONDITIONS are

- | | |
|--|-----------------------------|
| Weak circulation | } in cases of endocarditis. |
| Infective organisms in embolus | |
| Diseased vessels with collaterals unable to dilate, in arterio-sclerosis and atheroma. | |

SITE OF IMPACTION OF THE EMBOLUS.—At the bifurcation of vessels, e.g., where the Popliteal divides into anterior and posterior tibials—Femoral divides into superficial and deep—Brachial divides into radial and ulnar.

SPECIAL FEATURES.—

PAIN: Sudden, severe, and lasting

DRY GANGRENE appears in the extremities, e.g., the toes, especially in asthenic, anæmic people—Affects only the terminal vessels of the blocked trunk—Its extent gives no indication of the position of block—Usually limited by a joint.

MOIST GANGRENE : In a full-blooded patient—Or as a result of secondary venous thrombosis.

DRY AND MOIST GANGRENE is common, e.g., dry gangrene of toes with moist gangrene spreading up the calf.

TREATMENT.—

EMBOLECTOMY.—The site of the embolus can usually be determined, by local tenderness and the distribution of the gangrene. The vessel above and below is exposed and controlled by clamps. The vessel at the site of embolism is opened and the clot removed, and the vessel walls repaired by fine silk sutures, lubricated by paraffin, and held in finest sewing needles. It is of course essential that this operation should be done within a few days—preferably within twenty-four hours of the occurrence of the embolism.

Senile Gangrene.—

PREDISPOSING CONDITIONS.—Calcereous arteries whose collaterals cannot dilate—Weak circulation—Anæmia or some constitutional disease, e.g., nephritis.

EXCITING CAUSE.—Thrombosis in the arteries, often determined by some injury or inflammation, or cold.

SYMPTOMS.—

Premonitory : Cold feet, numbness, and cramps.

Dry gangrene beginning in one toe, usually the great toe.

With or without inflammation at its origin.

The gangrene has all the signs of the dry variety (*see above*).

Intense pain throughout.

Thrombotic Gangrene apart from traumatism is very rare.

Occurs after typhoid and other long cases of toxæmia.

It is usually in the leg, affecting the femoral.

Dry gangrene follows simple arterial thrombosis usually.

Puerperal Gangrene.—

Occurs after parturition.

Probably is due to thrombosis spreading from the pelvic to the femoral vessels.

Diabetic Gangrene.—Three distinct factors in its causation :—

1. A BLOOD CONDITION favourable to septic processes.
2. AN OBLITERATING ARTERITIS, especially in the tibials
3. NEURITIS, with some posterior sclerosis of the cord.

MOIST GANGRENE in its worst form is the common type.

Elderly patients—Chronic diabetes—Begins as a whitlow or suppurating corn—Rapidly spreads and is very fatal—Is very likely to give rise to diabetic coma.

DRY GANGRENE usually results from arterial sclerosis and neuritis—It is much less painful than other forms of dry gangrene—When neuritis is a chief cause it may be quite anæsthetic.

Gangrene—Varieties, *continued*.

Raynaud's Disease.—

Young patients—Generally women.

Associated with angioneurotic oedema, paroxysmal hæmoglobinuria, and other neuroses.

Affects fingers, toes, ears, or nose, in superficial patches, symmetrically on both sides of the body.

Of slow development, producing anæmia, cyanosis, and then a superficial slough.

Very painful.

Treat by galvanism or faradism. Brachial sympathectomy may be performed, with marked relief of symptoms; but as this relief is likely only to be temporary, it is better to do an excision of the lower cervical sympathetic ganglia.

Thrombo-angiitis Obliterans.—

Usually in the lower limbs.

Arterial thrombosis followed later by venous thrombosis.

Particularly in Polish Jews.

Before the onset of gangrene, intermittent claudication and various sensory changes occur.

Treat by excision of the lower lumbar sympathetic ganglia.

Direct Traumatic Gangrene.—

The parts which die are at the seat of injury.

The gangrene is caused by a lesion of the blood-vessels locally, thrombosis, obliteration by pressure or rupture.

Trophic disturbances and sepsis may take a large part in the causation.

1. CRUSHED LIMBS.—(See CONTUSED WOUNDS.)
2. SPLINT PRESSURE.—Too tight bandaging or ill-fitting or ill-padded splint—Usually over a bony prominence—Caused by a pressure-obliteration of vessels—Affects the superficial tissues over a bone.
3. BED-SORES occur over bony points on which a bedridden patient lies—Any prominent vertebral spine—Sacrum or posterior iliac spines—Trochanter—Heels.
Especially in condition of emaciation—Debility of fevers, e.g., enteric—Any spinal cord lesion, especially traumatic paraplegia.
TROPIC DISTURBANCE is the most important factor in spinal cases. The sores are then apt to be acute in their origin and progress.
SEPTIC DISCHARGES—e.g., urine and fæces—also often play an important part in the causation.
CONDITION.—Superficial skin slough, limited to points of pressure in most cases—Deep spreading sloughing in acute cases with spinal cord lesions.
PREVENTION.—Careful nursing, i.e., Smooth clean sheets—Constant cleansing from urine or fæces—Keeping the back as

dry as possible (washing with spirit after soap and water, dusting with boracic powder)—Use of water bed or air cushions to prevent localized pressure on the prominent bony points.

TREATMENT.—General cleanliness.

Stimulating ointments, e.g., resin or Friar's balsam.

4. ACTION OF CORROSIVE CHEMICALS.—Strong acids, e.g., sulphuric or nitric acids, carbolic acid—Strong alkalis, e.g., potash.

Course, varieties, and treatment are the same as in burns; but with acids and alkalis neutralization should be attempted if the injury is quite recent, so as to stop the corrosive action spreading.

Indirect Traumatic Gangrene.—Caused by an injury obstructing the vessels. The parts that die are at a distance from the injury.

1. LIGATURE OR THROMBOSIS OF MAIN ARTERY when the circulation is too weak or the vessels are too diseased to carry on the collateral circulation.

Similar to embolic gangrene.

2. OBSTRUCTION OF BOTH THE MAIN ARTERY AND VEIN.—By ligature or injury—By tight bandaging—By strangulation of an internal organ—Primary rupture of an artery and secondary pressure on veins.

Moist gangrene occurs up to the site of obstruction.

Infective Gangrene.—Caused by the direct toxic effect of micro-organisms.

1. LOCALIZED GANGRENE.—Usually staphylococcal. Here a dense condition of the tissues, e.g., dense bone or subcutaneous fascia, determines the gangrene because the vessels become strangulated by inflammatory exudation in an unyielding matrix.

a. NECROSIS OF BONE (*see below*).

b. CARBUNCLE OR BOIL OF THE SKIN (*see below*).

2. SPREADING GANGRENE.—

a. CANCRUM ORIS AND NOMA.—One attacks the mouth, the other the genitals—Affects weakly children after exanthemata—Chiefly streptococcal—Slough begins on the mucous membrane, and spreads right through to the skin—Destroys the whole cheek down to the bone.

Produces: sapræmia, septicæmia, or septic pneumonia.

TREATMENT.—Cut away all the affected parts.

Rub pure carbolic or nitric acid into raw surfaces.

Antistreptococcal serum.

Subsequent plastic operation.

- b. GAS GANGRENE, or Malignant œdema, or Acute emphysematous gangrene, or Acute traumatic gangrene.

Gas Gangrene, continued.

Exciting cause: Large lacerated wound with much dirt contamination, or virulent infection of a small wound.

ORGANISMS.—i. *Bacillus of malignant oedema.*

ii. *B. aerogenes capsulatus.*

iii. *B. oedematis.*

Usually mixed with other bacteria.

All are anaerobic.

All have intense peptonizing action and produce gas by their growth. They are commonly found in garden soil. The anaerobic bacteria spread rapidly in the sheath of the muscles, and for a time the infection is localized in one or more of these structures.

SIGNS.—Occur within 24 hours of infection.

Rapidly spreading acute cellulitis—Parts become dark coloured—Surgical emphysema is well marked—Sloughing only occurs if the patient lives long enough.

SYMPTOMS.—Acute septicæmia—High temperature, later becoming subnormal—Delirium succeeded by coma.

TREATMENT.—Multiple incisions into swollen tissues. Excision of the infected wound and of muscles specially involved. High amputation if the above fail to check the spread of infection.

Treatment of Gangrene.—

1. RENDER THE PARTS AS ASEPTIC as possible.

Spirit and biniodide of mercury 1-500 are specially valuable, because the spirit dries and hardens the skin.

2. KEEP THE PARTS DRY and encourage evaporation.

This maintains a dry type of gangrene, or

Converts a moist into a dry gangrene.

Dry sterilized dressings applied with all aseptic care.

HOT FOMENTATIONS should be used with great caution—

Never in cases of dry or aseptic gangrene,

But only when sepsis is obviously present in moist gangrene.

A fomentation is the surest way of converting a dry aseptic into a moist septic gangrene.

3. ELEVATION OF THE PARTS, KEEPING THEM WARM.

To encourage the circulation.

To empty the veins, and thus prevent the moist type of gangrene.

To prevent the spread of the gangrene in cases where the collateral circulation is very feeble.

4. AMPUTATION.—In all cases except, perhaps,

a. Senile gangrene with marked calcareous arteries and feeble general condition or albuminuria.

- b. Diabetic gangrene with marked acetonuria (acidosis), or commencing coma.
- c. Acute infective gangrene which has involved the trunk, or in which septicæmia has already developed.

WHEN AND WHERE TO AMPUTATE must be determined by

- a. The nature of the gangrene, dry or moist.
- b. The presence and virulence of septic processes.
- c. The condition of the main blood-vessels.
- d. The general condition of the patient.

WHEN TO AMPUTATE (i.e., at what period) ?

In dry gangrene: Directly a definite line of demarcation appears, or directly the final death of the part is inevitable—When pain and exhaustion are intolerable.

In moist gangrene: Directly active septic processes or a line of ulceration are evident.

WHERE TO AMPUTATE ?

With diseased vessels: High amputation, e.g., lower third of thigh for senile gangrene of toes.

With active sepsis but healthy vessels: Amputation well above the inflamed area, e.g., middle of calf for gangrene of foot.

With healthy vessels and no sepsis: Amputation through the line of demarcation, or just above it.

FROST-BITE AND BURNS.

Frost-Bite.—

CAUSES.—(1) Direct effect of cold on exposed parts; (2) Pressure of inflammatory exudation caused by too rapid thawing.

CHARACTERS.—

- a. SUPERFICIAL DRY GANGRENE of nose, ears, fingers, or toes—The slough which separates is superficial—The process is painless—It occurs as the direct effect of the cold.
- b. MOIST GANGRENE of an inflammatory character from too rapid thawing—Is extremely painful—Often ends in superficial ulceration rather than actual gangrene.

TREATMENT.—Very gentle gradual thawing—Rubbing with snow-water—Elevation of part, with gentle bandaging, to prevent congestion—Keep part aseptic, dry, and elevated when gangrene has occurred.

Burns and Scalds.—Produce inflammation, ulceration, or gangrene.

DEGREES OF INJURY produced by burns or scalds.—

1ST DEGREE.—Erythema—Local congestion of the skin. Only dangerous if extensive, and then shock and widespread superficial vasomotor paralysis may cause death.

2ND DEGREE.—Vesication—Epidermis is raised in blisters—Danger to life is the same as in 1st degree.

3RD DEGREE.—Destruction of epidermis—Raw dermis with naked nerve papillæ is exposed—The most painful form of

Burns and Scalds, *continued*.

burn. Healing is rapid, regeneration complete—No contraction results.

4TH DEGREE.—Destruction of the dermis—The nerve terminals are destroyed—All true skin structures are lost in affected area. Healing involves great and deforming contraction—Scar formed is merely fibrous tissue covered by epidermis, and contains no proper skin elements, hence is devoid of hair, sweat and sebaceous glands, and but few nerves, lymphatics, or blood-vessels.

5TH DEGREE.—Destruction below the layer of deep fascia—Muscles are injured or destroyed—Deep muscular fibrosis results from healing.

6TH DEGREE.—Charring to the bone, or total gangrene.

The last three degrees involve all the dangers of inflammatory fever and septic absorption.

STAGES IN THE COURSE OF A BURN.

1ST STAGE: SHOCK.—At the time of injury: Severe (*a*) in proportion to the extent of the surface; (*b*) In children; (*c*) In burns of trunk, especially abdomen.

When the shock is fatal, the internal organs, and especially the portal system, are found engorged, as though from vasomotor paralysis.

2ND STAGE: INFLAMMATION.—During the separation of dead tissues. Lasts one or two weeks, in proportion to the depth, extent, and septic infection of the burn. Any variety of septic complication may ensue—Gastro-intestinal inflammation, ulceration may result from septic absorption—Duodenal ulcer in an acute form may cause death from perforation or bleeding.

3RD STAGE: HEALING.—From time of separation of dead tissues until recovery—Will vary according to the degree—In first 3 degrees merely involves vascular changes or regeneration of epidermis from dermis—In 4th and 5th degrees will involve the cicatrization and contraction of an ulcer—In 6th degree it will be similar to the changes which follow massive gangrene.

CAUSES OF DEATH.—Shock—Gastro-intestinal inflammation and ulceration—Septic absorption.

TREATMENT.

FOR EXTENSIVE BURNS WITH MUCH SHOCK.—Cases presenting much shock, especially children, should be treated by hot air. A cradle is placed over the patient and heated by electric lamps or hot bottles, the whole being covered by blankets.

IN FIRST DEGREE.—Dust with boracic acid, cover from the air.

IN SECOND OR THIRD DEGREE.—Tannic acid: Cut blisters, remove damaged epithelium, clean surface with ether (under influence of morphia or general anæsthetic). Prepare fresh 2 per cent solution of tannic acid, by dissolving powder in water, and spray on, every hour or two, for 18 to 24 hours,

making fresh solution each time. Keep part under electric-heated cradle, to dry the crust.

IN DEEPER BURNS.—Render aseptic (under anæsthetic if necessary).

Dress with oiled lint, carron and eucalyptus oil (10 to 1), or picric acid.

Ambrine or a special preparation of paraffin wax. This is melted and in the hot liquid state it is sprayed or painted over the burn. A thin layer of gauze or wool is then applied and more liquid wax. It causes less pain and less injury to new epithelium on renewal of dressings.

Large wounds, the healing of which will involve much contraction, require skin-grafting.

Amputate only if a limb is clearly rendered useless, or if severe sepsis occurs.

SKIN-GRAFTING.

Uses.—(1) To facilitate healing of any large superficial wound when much skin is destroyed, or (2) Any large ulcer with great loss of skin; (3) When as the result of a burn of the 4th or worse degree a wound is left which can only heal by great contraction.

Methods.—

1. REVERDIN'S.—Minute fragments of epidermis only. Hardly ever used now.

2. THIERSCH'S.—Large pieces of epidermis with some dermis. Is used when large areas have to be covered, e.g., after amputation of the breast, in closing a large burn.

PREPARATION OF THE WOUND.—It must have no active sepsis or irritating discharges—It must be recent and vascular—Exuberant granulations must be scraped away, but small recent vascular granulations may be left—Bleeding must be stopped by gauze pressure over protective while grafts are cut.

PREPARATION OF GRAFTS.—Skin must be rendered aseptic—Cut grafts with flat, sharp razor—Hold skin flat and tense with strips of wood—Keep razor surface wet with water all the time—Cut the grafts as large as possible—Best taken from the thigh.

The cut should be down into the fibrous vascular layer of the dermis, but not through it.

The graft beds are dressed with simple ointment, and heal quickly, because the deep layers of skin regenerate those taken away.

LAYING THE GRAFTS.—Grafts have been placed in warm saline fluid—Laid on the wound absolutely flat—Wound surface should be completely covered—Dressed over perforated tin foil—Or left with no dressing in actual contact—Change the dressing every three days—Use no chemical antiseptics throughout.

Skin-Grafting, continued.

3. **WHOLE THICKNESS OF THE SKIN.**—In covering small wounds, e.g., eyelids, or any part of the face, e.g., after the removal of rodent ulcers.

Thin hairless skin should be chosen, e.g., prepuce, parts of the outside of the arm; or a pedicled flap may be taken from the chest (*Fig. 8*).

The graft is cut a little larger than required—Is sewn accurately to the edges of the gap—Firm pressure is needful afterwards. If graft has a pedicle, the latter is cut on the eighth day.

This method gives a more satisfactory result than Thiersch's, because the graft consists of the whole skin thickness and not mere epidermis.

4. **TUBULAR GRAFTS.**—The whole thickness of the skin with the subcutaneous tissue is dissected up as a flap, remaining attached at one end. The flap is then sewn together as a tube and the free end of the tube is implanted into the edge of the area which it has to cover finally. After a week or more, the base of the tube is cut from its original site. Lastly, it is unfolded so as to convert the tube once more into a flap and then spread over the raw area it has to cover and sutured in place.

In this way, when the face has been extensively burned, the whole skin can be replaced by one or more flaps from the chest; or the skin of the thigh may be brought down to cover the ankle (*Fig. 9*).



Fig. 7.—Dry gangrene of foot, showing line of demarcation.

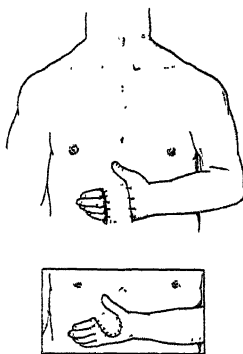


Fig. 8.—Skin-grafting by pedicled flap.

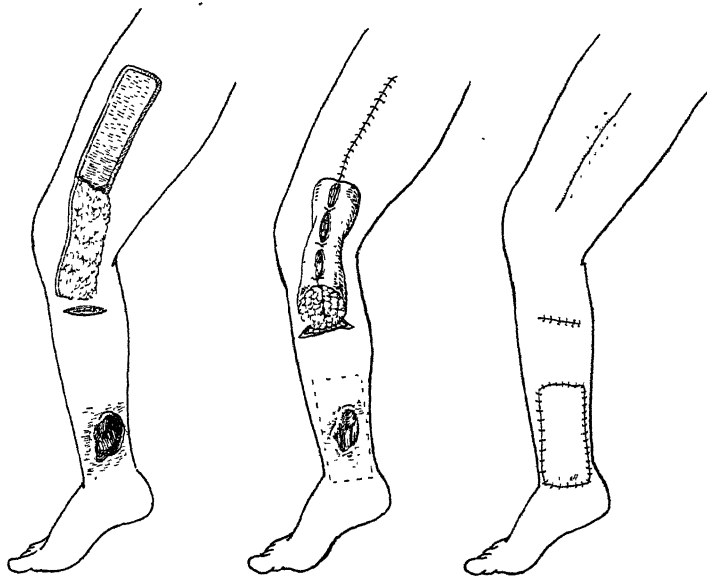


Fig. 9.—Tubular skin-grafting. A long flap is taken from the thigh with pedicle below \times . It is turned down and its free end sewn into the middle of the leg. Its edges are sewn together to form a tube. Ten days later, the original pedicle is cut and the graft turned down and sewn over the raw area at the ankle. Later the secondary pedicle is cut away.

CHAPTER IV.

ACUTE SURGICAL INFECTIONS.

CELLULITIS.

Definition.—Septic inflammation of subcutaneous and fascial connective tissue.

Causes.—

Injury, or wound, or abrasion of skin or mucous membrane—especially deep wounds with small external openings.

BACTERIA.—Staphylococci (*albus* and *aureus*) (slight cases), streptococci (severe cases), or bacillus of malignant œdema (emphysematous gangrene).

PREDISPOSING CAUSES.—Albuminuria, diabetes, debility.

Symptoms.—

INCUBATION PERIOD of about two or three days, during which there is some general malaise.

ONSET.—Usually with a sharp rise of temperature and rigor—Rarely a subnormal temperature occurs, and this in the worst cases.

CONSTITUTIONALLY.—All symptoms of fever, with great pain and sleeplessness—Delirium in very bad cases. There may be large subcutaneous abscesses (staphylococcus), or a spreading sloughing of the cellular tissue (streptococcus). The tendency is to spread up the limb along the lines of the fascial planes rather than to burst through the skin.

LOCALLY all the signs of inflammation occur: Tenderness, redness, brawny induration and œdema—Intense throbbing pain—The outline and margin are very indefinite and ill-defined.

COMPLICATIONS.—Some form of serositis by extension, e.g., Meningitis from disease in the scalp or orbit—Pericarditis, Pleurisy, Mediastinitis, from cellulitis of the neck—Peritonitis from pelvic cellulitis—Septicæmia or Pyæmia from general infection.

Treatment.—

MULTIPLE INCISIONS down to the deep fascia.

HOT FOMENTATIONS or immersion in continuous hot bath.

PASSIVE HYPERÆMIA.

ANTISTREPTOCOCCUS SERUM in suitable cases.

Special Forms.—

SCALP.—The affected parts are bounded by the occipito-frontalis aponeurosis, i.e., by the superciliary ridges in front, superior curved lines of the occiput behind, the temporal ridges at the side.

The whole scalp over this area may become lifted up by a bag of pus. **MENINGITIS** or necrosis of the skull may follow.

ORBIT.—Caused by penetrating wounds or extension from boils on the eyelids.

RAPID COURSE.—Very great pain, with high temperature and delirium. The eyeball is pushed forwards and vision lost.

COMPLICATIONS.—Meningitis, septic thrombosis of the cavernous sinus, suppurative panophthalmitis, optic neuritis, destruction of the ocular muscles, and retraction of eyelids.

TREATMENT.—Free incisions and fomentations. The eyeball must be sacrificed by incision or excision in severe cases or where panophthalmitis supervenes.

CERVICAL OR SUBMAXILLARY CELLULITIS (LUDWIG'S ANGINA).—Affects the deep cervical fascia, usually beginning in the submaxillary region and spreading rapidly downwards and inwards.

CAUSED by an intrabuccal or pharyngeal infection, usually in old and debilitated people.

RAPID SLOUGHING and suppuration occur in the plane of the deep fascia, at the root of the tongue, and spreading down the pretracheal fascia to the superior mediastinum and pericardium, or down the prevertebral fascia to the posterior mediastinum and pleura.

COMPLICATIONS.—Edema glottidis—Sublingual abscess—Suppurative mediastinitis—Pericarditis—Empyema.

TREATMENT.—Free incisions, especially in the mid-line above the hyoid bone—Tracheotomy for edema glottidis.

PELVIC CELLULITIS.—

CAUSES.—Septic conditions of the uterus, lacerated cervix, punctured wounds of the rectum, diseases of the bladder and prostate.

SIGNS.—Constitutional signs are severe. The uterus is pushed to one side, and a phlegmon arises on one side of the pelvis and spreads up the round ligament or cord to the inguinal region. An abscess forms either in the pelvis or in the inguinal region.

DIAGNOSIS.—An inguinal abscess of this kind has to be distinguished from: (1) Bubo, or other lymphatic swellings; (2) Inflamed hernia; (3) Psoas abscess; (4) Appendicitis.

COMPLICATIONS.—Abscess may burst into vagina, rectum, bladder, or intestine.

TREATMENT.—Hot douches and fomentations. Open through the vagina or the inguinal region.

Infections of the Hand.* —

FELON.—Septic infection of the pulp of the distal phalanx.

Pus collects in the connective-tissue space, and by its tension deprives the bone of blood-supply.

If unrelieved, the result is necrosis of the ungual phalanx; but the epiphysis does not suffer.

TREATMENT.—Incision on side of pulp of finger.

PARONYCHIA.—Septic infection of the base of the nail-bed.

Begins at one side and spreads to the other.

TREATMENT.—Lateral incisions, removing part or the whole of the base of the nail (*Fig. 10*).

WHITLOW.—This term has been loosely applied to various infective inflammations of the fingers, and should be replaced by the more definite entities described below.

SUBCUTICULAR OR SUBEPITHELIAL INFECTION.—A localized inflammation causing a serous and then purulent bleb beneath the epidermis.

LYMPHANGITIS.—Usually a streptococcal infection through a minute wound or abrasion.

Bright-red blush, followed by pitting œdema.

Spreads rapidly up the arm, first by red streaks.

Glands at the elbow and axilla become enlarged.

Fingers can move; no special tenderness over tendon sheaths.

May present several degrees, viz.: (1) A localized fugitive process; (2) A localized process with extension into deep planes (cellulitis) or tendon sheaths; (3) A rapidly fatal septicæmia.

TREATMENT.—Fomentations and rest, avoiding incisions unless local suppuration develops. Flat elastic band above elbow to promote hyperæmia and to localize infection.

CELLULITIS.—May be streptococcal or staphylococcal.

Begins like lymphangitis.

Causes suppuration under deep fascia, with sloughing of latter. Dark-red, brawny, indurated swelling chiefly at the back of the hand and forearm.

TREATMENT.—Multiple incisions and fomentations.

TENOSYNOVITIS.—Infection of tendon sheaths, usually of the flexor tendons.

ANATOMY (*Figs. 12, 13, 14*).—

The three middle digits have sheaths only as far as the front of the knuckle-joints.

The little-finger sheath usually extends into a large sheath in the hand which goes above annular ligament and is known as the ulnar bursa.

* Kanavel, *Infections of the Hand*.

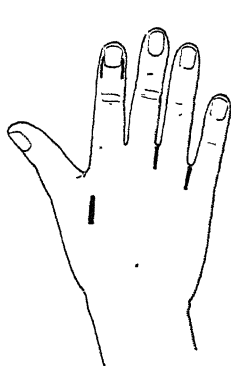


Fig. 10.—Incisions employed in paronychia and upon the dorsum of the hand in fascial space infection. That on radial side of index metacarpal is for the thenar space. Those in the third and fourth clefts are for the mid-palmar space.



Fig. 11.—Treatment of tenosynovitis of fingers. Lines showing area of possible incisions for infections of the various tendon sheaths. (In case of doubt the free incision of the whole sheath is to be advised.)

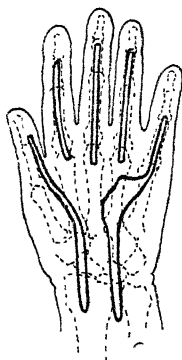


Fig. 12.—Diagram to show flexor tendon sheaths.

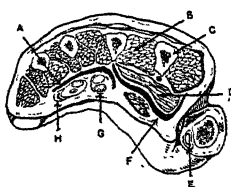


Fig. 13.—Cross-section of hand 3.5 cm. proximal to the metacarpophalangeal joint. A, Middle palmar space; B, Interosseous muscle; C, Metacarpal; D, Adductor pollicis; E, Flexor pollicis; F, Thenar space; G, Finger flexors; H, Ulnar bursa.

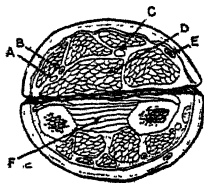


Fig. 14.—Cross-section of forearm 7 cm. above radial styloid, showing incision made transversely in juxtaposition to ulna and radius through anterior interosseous space, demonstrating that an incision can be made here and not injure important vessels and nerves. Note tissue between radial artery and line of incision. A, B, Radial artery and nerve; C, Median nerve; D, Flexor tendons; E, Ulnar artery; F, Pronator quadratus.

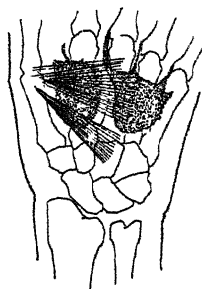


Fig. 15.—Thenar and mid-palmar fascial spaces injected with bismuth. The cross-shading is the adductor pollicis. Note the extension of the spaces along the tendons of the lumbrical muscles.

(Figs. 10-15 after Kanavel.)

Tenosynovitis in the Hand, *continued*.

The thumb flexor sheath extends similarly into a separate sheath in the hand and above the wrist known as the radial bursa.

The ulnar and radial bursæ frequently communicate.

SIGNS.—

Exquisite tenderness to pressure over affected sheath

Finger is rigidly flexed.

Great pain on passive extension.

EXTENSION OF INFECTION.—

Thumb and little finger: Infection spreads into radial or ulnar bursa, and thence above into forearm deep to profundus tendons.

Three middle digits: Infection spreads into one of the fascial spaces in the palm.

TREATMENT.—

Open over point of maximum tenderness and swelling.

Make lateral incisions on front of fingers between the joints.

Open ulnar or radial bursa by incision through the palm, as indicated in diagram (*Fig. 11*).

Open forearm suppuration by lateral incisions opening the space deep to the profundus tendons (*Fig. 14*).

After opening, retain flat elastic band above elbow tight enough to constrict veins without stopping pulse, for 12 hours at a time, to promote hyperæmia and discharge.

RESULTS.—Very liable to be followed by sloughing of the tendons.

FASCIAL SPACE INFECTION.—There are two main loose fascial spaces in the hand, viz.: (1) Thenar space: In the thumb muscles, extending into palm as far as middle metacarpal. (2) Middle palmar space: Beneath the main flexor tendons and the palmar fascia (*Figs. 13, 15*).

Each of these spaces is easily infected from the tendon sheaths, the thenar space from the thumb or index finger, the mid-palmar space from the middle, ring, or little finger (*Fig. 14*). Each space extends along the corresponding lumbrical muscle to the interdigital clefts.

THENAR SPACE ABSCESS.—Spreads up radial side of index finger or between index and middle fingers.

Open by incision on dorsum, on radial side of neck of index metacarpal (*Fig. 10*).

MIDDLE PALMAR SPACE INFECTION.—May spread up the lumbricals to clefts between middle, ring, and little fingers.

Open by incision in third and fourth clefts (*Fig. 10*).

ERYSIPELAS.

Definition.—A very contagious disease; consisting in an infective inflammation of the skin or mucous membrane.

Causes.—

Predisposing: (1) A wound or abrasion; (2) Constitutional debility; (3) Bad hygiene.

Exciting: *Streptococcus erysipelatis*, which is indistinguishable from the *S. pyogenes*.

Pathology.—The lymphatics of the skin in the margin are crowded with chains of streptococci. In the regions where the disease has come and gone there is marked leucocytosis but no cocci.

Symptoms.—Malaise with a rigor and headache.

RASH appears within twenty-four hours. It appears first round the wound, which breaks open. It is of a vivid red colour, which fades on pressure. Pain and swelling are not much marked. The eyelids and scrotum when affected become very oedematous. Vesicles and bullæ form superficially, and a fine desquamation occurs, with some staining of the skin as the rash fades away.

THE MARGIN is well marked, rather gyrate, slightly swollen, rapidly advancing.

Sloughing of the skin rarely occurs, and then usually in cases of scrotal affection.

LYMPHATIC GLANDS in the neighbourhood are enlarged and tender.

EXTENSION may occur by the lymphatics or veins to the deep structures, or pyæmia may be set up.

CONSTITUTIONALLY.—Patient is very ill, with high temperature— 102° – 104° . Delirium is frequent, especially when the scalp is affected. Vomiting is common.

COURSE.—Tends to spontaneous recovery in one to three weeks.

Varieties.—

FACIAL ERYSIPELAS is often apparently idiopathic and recurrent. It is accompanied by great oedema. It is liable to be complicated by meningitis.

FAUCIAL ERYSIPELAS.—Spreads from the exterior to the pharynx. Causes great swelling of the parts, with a tendency to oedema glottidis. Sloughing or ulceration may follow. Massive enlargement of the glands at the angle of the jaw.

SCROTAL ERYSIPELAS.—Causes great oedema, and in children a tendency to sloughing.

CELLULO-CUTANEOUS ERYSIPELAS partakes of the character of both cellulitis and erysipelas, affecting the skin and subcutaneous tissue. The margin is less sharply defined; the tendency to general septic infection and sloughing of the skin is greater than in either of the simpler diseases.

Diagnosis.—

THE EXANTHEMATA, especially scarlet fever. In these the rash appears at the same time in different parts of the body.

Erysipelas—*Diagnosis, continued.*

The rash has specific characters, and there are other symptoms, e.g., coryza or tonsillitis.

CELLULITIS.—There is more swelling and oedema, and the margin is not well defined.

DIFFUSE ERYTHEMA NODOSUM.—Occurs generally on the legs, with few or slight febrile symptoms. Isolated and ill-defined nodules are its chief feature.

ERYTHEMA SOLARE (sun-burn) is limited to the parts exposed ; it does not spread, and there is but little fever.

ACUTE ECZEMA.—There is a copious exudation, and little tendency to pass away.

Effect on other Lesions.—Chronic ulcers, simple, tuberculous, or specific, may rapidly heal. Sarcomata have disappeared after erysipelas, this providing the basis for Coley's treatment of the former.

Treatment.—

STRICT ISOLATION, especially from surgical patients.

FOMENTATIONS and dressings to relieve pain and limit the diffusion of the virus.

Painting with 40 per cent aqueous solution of **ICHTHYOL** after scarification.

Painting the healthy skin beyond the rash with irritants, e.g., **IODINE** or **SILVER NITRATE**, or by scarification, to produce leucocytosis.

ANTISTREPTOCOCCUS SERUM, 20–30 c.c., given subcutaneously twice a day in bad cases.

SEPTIC INFECTION.

Causation.—An infection by the ordinary pyogenic bacteria, which are derived from the skin or mucous membrane of the patient, or by contact with infected materials or instruments.

Local Signs.—The wound becomes inflamed, i.e., painful with red and swollen edges. Cellulitis may spread to neighbouring structures. When a stitch is the infective agent, the signs may be later and less manifest, and appear round the stitch-hole.

Local Treatment.—Removal of stitches, with hot fomentations. Drainage or packing with iodoform. Daily irrigation with peroxide solutions.

Constitutional Signs of Infection.—These may be of five different grades according to the amount and character of the toxic agent: (1) **SEPTIC TRAUMATIC FEVER**; (2) **HECTIC**; (3) **SAPRÆMIA**; (4) **SEPTICÆMIA**; (5) **PYÆMIA**.

Septic Traumatic Fever is the fever which accompanies an ordinary septic wound. It is most marked when the wound is closed. The temperature rises to 101°–103°, often with a rigor. It falls rapidly when the wound is opened, and is at an end when the layer of granulations prevents further absorption.

Hectic Fever is caused by the CONSTANT ABSORPTION OF SMALL DOSES OF TOXINS. Usually the temperature rises to 99° – 101° every evening. It accompanies chronic suppuration, especially that of septic tuberculous foci.

Sapræmia is caused by the absorption of a LARGE DOSE OF TOXIN. A large or virulent infective focus exists (e.g., a septic placental remnant in utero, or a localized appendicitis), and from this toxins (but not bacteria) enter the circulation.

SYMPTOMS.—

A RIGOR, with rapid rise of temperature to about 104° , is the first symptom. In the worst cases the temperature remains subnormal.

VOMITING AND DIARRHŒA, delirium or coma, dyspnoea, or albuminuria, may occur, according to the organs which react most to the toxins.

THE USUAL SIGNS OF SEVERE FEVER—dry tongue, quick pulse, scanty urine, and headache—are the rule.

All the symptoms subside rapidly when the infective focus is freely opened and cleared out.

TREATMENT must be directed to the cause. Also hypodermic, venous, or rectal saline transfusions are of the utmost value in diluting and excreting the toxins.

Septicæmia is caused by the absorption and development of bacteria in the blood of the patient.

BACTERIOLOGY.—

Streptococcus pyogenes is the cause in more than half the cases, and nearly all cases of puerperal origin, and most of those of ulcerative endocarditis.

Pneumococcus and *Staphylococcus* are next in frequency. *Bacillus coli*, *B. œdematis maligni*, *B. pyocyaneus*, and *Gonococcus* are rarer causative agents.

PREDISPOSING CAUSES.—

Special virulence of the bacteria, e.g., in small post-mortem wounds—Special debility of the patient—Large lacerated wound area.

SYMPTOMS.—

LOCAL INFLAMMATORY signs may be of any degree.

TEMPERATURE rises to 104° – 105° with a rigor, and remains fairly high without marked intermissions. The temperature becomes subnormal, whilst the pulse rises, in fatal cases.

The symptoms are the same as those of sapræmia, but of a further intensity.

Blood-stained diarrhœa, blood and albumin in the urine, petechiæ in the skin, and rapid coma are all very significant.

COURSE.—It is usually fatal in five to seven days.

POST-MORTEM SIGNS.—

These are mostly due to early decomposition and to HÆMOLYSIS, i.e., solution of the red corpuscles. Coagulation and rigor

Septicæmia—Post-mortem Signs, continued.

mortis are ill marked. The blood serum is lakey. Hæmorrhages are seen in the intima of vessels and heart. The serous cavities contain blood-stained exudation. The viscera, especially the spleen and lungs, are soft, pulpy, and congested, and their epithelium has undergone CLOUDY SWELLING.

Similar phenomena are seen after death from all acute infectious diseases, also in sapræmia, pyæmia.

DIAGNOSIS.—

IN SAPRÆMIA AND SEPTIC TRAUMATIC FEVER there are three points to help in the distinction: (1) The presence of an inflamed wound or local infective focus in which the local signs are in proportion to the constitutional; (2) The rapid amelioration of symptoms on freely opening the infective focus; (3) The fact that repeated blood examinations give a negative bacterial result.

HYPERACUTE EXANTHEMATA, in which the patient dies before the rash appears, are practically cases of acute septicæmia, indistinguishable from those of traumatic origin.

PYÆMIA is distinguished by the repeated rigors, the intermittent temperature, and local abscesses.

TREATMENT.—

Local treatment on general lines must be undertaken, but is usually too late to avail.

Concentrated scarlet fever antitoxin globulins—20 c.c. intramuscularly or intravenously—in severe cases is the best remedy in all streptococcal infections.

Intravenous or other means of copious saline infusions help to eliminate the poisons.

Vaccine treatment.

Pyæmia.—Is caused by the diffusion of septic emboli throughout the circulation.

BACTERIOLOGY.—

STREPTOCOCCUS is the commonest cause. *Bacillus coli*, *B. pyocyaneus*, *Staphylococcus*, *Pneumococcus*, *B. typhosus* are all rare.

CAUSES.—Infective phlebitis—Osteomyelitis—Infective endocarditis—Middle-ear disease—Puerperal infections—Any septic focus. In all these there is a septic thrombus formed in the veins, particles of which become washed into the general circulation.

PATHOLOGY.—Thrombi containing living bacteria form emboli which are caught in the capillaries of different organs. The lungs suffer first, and then the kidneys, brain, liver, spleen, and large joints. In portal pyæmia the liver suffers first and most.

Infarctions occur as wedge-shaped hæmorrhagic areas at each point of infection.

Abscesses develop from each septic embolus.

Some degree of septicæmia usually co-exists.

VARIETIES.—

IN ACUTE PYÆMIA there is also marked septicæmia, and death occurs before any of the abscesses have time to become prominent.

IN CHRONIC PYÆMIA no bacteria can be found in the blood. The abscesses develop at intervals and attain a large size. They are often in bones or joints.

SYMPTOMS.—All those of septicæmia and sapræmia may be manifest.

RIGORS of extreme severity and regular recurrence are the distinguishing feature. Dyspnoea, cyanosis, and sweating follow each rigor. They occur at intervals of one or two days.

AN INTERMITTENT FEVER, with rises to 104° – 106° , accompanying the rigors, is also well marked.

LOCAL INFARCTIONS AND ABSCESSES appear about the end of the first week. The visceral infarctions are usually small, but may be notified by sudden stabbing pain or the development of pleurisy.

SUPERFICIAL ABSCESSES, e.g., in joints, often develop rapidly and without any signs of inflammation. When opened there is no attempt at granulation or inflammatory repair.

DURATION.—Varies from ten days to several months.

POST-MORTEM SIGNS are those of septicæmia, together with:

- (1) Some primary focus, usually of a bony nature, in which necrosed bone is found with neighbouring veins filled by breaking-down septic clots;
- (2) The infarctions or abscesses in different organs.

PROGNOSIS depends upon: (1) The accessibility of the primary lesion; (2) The early treatment of the primary focus; (3) The vitality of the patient and the virulence of infection; (4) The presence of septicæmia as indicated by bacteria free in the blood-stream.

TREATMENT.—

LOCAL.—Radical treatment of primary focus—Opening and scraping septic wounds—Scraping out septic bony cavities—Amputation of a septic limb—Opening and plugging a septic sinus.

GENERAL.—Antistreptococcus serum—Tonic treatment by drugs and food.

TETANUS.

A toxæmia due to a local infection by the *Bacillus tetani*.

Causes.—

PREDISPOSING.—Hot climates. Agricultural labourers and stable attendants are specially liable to contact with contaminated soil.

EXCITING.—A wound—generally septic, sometimes merely contused or punctured—is infected by the tetanus bacillus.

Tetanus—continued.

Bacillus.—Occurs in ordinary garden earth and in road sweepings. Consists of a delicate straight rod which develops a spore at one end (drum-stick bacillus) (*see Fig. 1, p. 9*). It is provided with flagellæ. It is a strict anaerobe, but can grow in surface wounds where pyogenic cocci absorb all the oxygen. It stains by Gram's method—Grows in the depth of stab cultures—Its spores are very resistant to heat and chemicals—It produces no effect on inoculation unless the tissues are depressed by injury or toxic effect of sepsis.

Pathology.—The bacilli remain localized to the point of infection. The disease is a pure toxæmia produced by the absorption of toxins from the wound. The toxins travel to the central nervous system in the perineural sheaths. In the central nervous system the tetano-toxin acts something like strychnine as a powerful spasmodic poison.

Post MORTEM: Redness and congestion of the nerves leading from the infected focus. Softening and ecchymosis in the brain and cord. Molecular changes in the motor nerve cells. Rupture of muscles.

Symptoms of Acute Tetanus.—

INCUBATION PERIOD.—Three days to one month. Patients who have had prophylactic antitoxic serum may present an incubation period of 3 to 12 months. Any surgical operation on the wound area is liable to rouse up the latent infection.

EARLY SIGNS.—Stiffness and cramps in the jaw muscles, and in the neck.

SPASMS.—Trismus or lockjaw—Rigidity of the cervical muscles—Facial spasm (risus sardonicus)—Pharyngeal spasm causing dysphagia—Trunk muscles producing opisthotonus (backward arching), emprosthotonus (forward arching), or pleurosthotonus (lateral arching)—Abdominal muscles, especially the recti, are strongly affected—Respiratory muscles are attacked last.

CHARACTER OF SPASMS.—Strong, very painful, and continuous (tonic) contractions, lasting several minutes at a time. Are determined by any sensory stimulus, e.g., light, sound, or a draught. Often cause rupture of the muscles.

TEMPERATURE is always high at the end (110°), and is usually raised throughout. Sweats are profuse.

CONSCIOUSNESS is unimpaired, and the expectation of the convulsions produces great mental suffering.

DEATH occurs in two to six days from exhaustion or asphyxia.

Chronic Tetanus is the milder form of disease. The incubation period is longer, fever is absent, and the convulsions are much more limited and less severe.

Cephalo-Tetanus is a special form following some head injuries. Facial paralysis occurs in conjunction with other symptoms, e.g., spasms. Pharyngeal spasm and mania are prominent, and give it a resemblance to hydrophobia.

Diagnosis.—

STRYCHNINE POISONING causes similar symptoms, but of much more rapid onset. The muscles become quite relaxed between the spasms, and the hands are often affected.

HYDROPHOBIA.—The convulsions are clonic. Hallucinations and mania well marked. The muscles of deglutition and respiration are markedly affected.

SIMPLE TRISMUS, as from dental caries or affections of the temporo-maxillary joint, shows no affection of the neck muscles, and is generally unilateral.

Prognosis.—Is always bad, but when the incubation period is long there is a better chance of recovery. Whereas 96 per cent die when the incubation period is under ten days, only 55 per cent die if it is three weeks or over. Mortality has been greatly reduced by prophylactic inoculation.

Treatment.—

EXCISION of the infected wound should be employed as a prophylactic measure only. If tetanus develops, then the less the original wound is disturbed the better.

ANTITETANIC SERUM is a pure antitoxin, and has little effect on the toxins which have already combined with the cells of the central nervous system.

Antitoxic serum should be given :—

For prophylaxis.—500 units subcutaneously : (a) At earliest possible moment in every case with an earth soiled wound ; (b) Prior to any operation on a patient who has been exposed to infection within 12 months.

For cure.—5000 units intravenously, 5000 units intrathecally.

In suitable cases also 5000 units into main nerve sheath.

FEEDING is by a rubber tube behind the teeth or through the nose or rectum.

ABSOLUTE QUIET and avoidance of all sensory stimuli.

DRUGS.—Chloral, bromide, and chloroform. Chlorotone in 10- to 30-gr. doses, administered by the rectum.

INTRASPINAL INJECTIONS OF MAGNESIUM SULPHATE.—One drachm of a 5 per cent solution injected into the spinal theca is of great value in stopping the convulsions. It is to be repeated daily or when the convulsions begin to recur.

ANTHRAX.

The Bacillus Anthracis (*see Fig. 1*) is large and long : 5 to 20 μ long and 1 to 1.5 wide. It is aerobic, and liquefies gelatin. It forms spores when growing outside the body in the presence of oxygen. These spores are very resistant to chemicals and heat.

Infection usually takes place by the contact of butchers, graziers, leather or wool workers with the diseased sheep or cattle. In the latter it causes splenic fever, and the beasts, their carcasses, and skin retain the infection. *Incubation Period*, 3 hours to 3 days.

Malignant Pustule is the result of cutaneous inoculation by anthrax. Usually occurs on the face, neck, or arms. (1) An angry red pimple; (2) A crop of vesicles upon an infiltrated base; (3) A central black slough surrounded by vesicles and a large zone of oedema, are the stages in its appearance, which it goes through in four or five days. Then the temperature rises and grave septicæmia is caused by the distribution of the bacilli. Special symptoms may be due to the involvement of the lungs, intestine, or nervous system.

Anthrax Oedema is a more virulent form of local infection, in which widespread oedema with multiple cutaneous sloughs precedes a rapidly fatal septicæmia.

Woolsorters' Disease is an anthrax septicæmia without external lesion. Usually the infection is by the lungs, and a severe PLEUROPNEUMONIA is set up. More rarely the intestine is the primary focus, and painful diarrhoea with passage of blood occurs, as the symptom of ENTERITIS. In either case the result is usually fatal.

Treatment.—EXCISION of cutaneous foci of infection; but this is by no means essential. Early injection with SCLAVO'S SERUM.

HYDROPHOBIA.

Cause.—Transmission of the virus by the bite or lick of a rabid animal, usually a dog.

Virus is said to be represented in one stage of development by so-called Negri bodies found particularly in the hippocampus major of the dog.

Rabies in the Dog occurs three to five weeks after infection. It manifests three stages: (1) An altered disposition, in which the dog sulks or is snappy; (2) A stage of maniacal excitement, in which it attacks any one it meets; (3) A paralysed condition affecting the hind limbs and jaw. The dog throughout has no dread of water, but drinks freely.

Hydrophobia in Man.—Incubation period is six weeks up to a year.

A mental change—terror, delusions, and suspicions, with insomnia—is the first symptom group.

Clonic contractions of the tongue and pharynx, which later spread to other parts as general convulsions. Any sensory stimulus gives rise to these, especially the sight of water or any attempt to swallow.

Mouth is filled with tenacious mucus.

Respirations are irregular.

Violent homicidal mania is a rare occurrence.

Death occurs in two to seven days from exhaustion or glottic spasm.

Post-mortem changes are: Inflammation of the medulla oblongata, with engorgement of the salivary glands.

Treatment.—The dog should be kept under observation until the diagnosis is certain.

The bitten part should be EXCISED or CAUTERIZED after a tourniquet has been placed on the limb above.

PASTEUR'S TREATMENT should be tried as soon as possible. It consists in injections of preparations from the spinal cords of artificially inoculated rabbits, beginning with those whose toxicity has been rendered weak by long desiccation, and later using more virulent preparations.

When the disease has manifested itself, sedatives—chloral, bromide, and chloroform—are the only palliation.

GLANDERS,

Etiology.—It is primarily a disease of horses and other allied animals, in whom it causes ulcerative lesions of the nasal mucous membrane. A specific organism, the *Bacillus mallei*, has been isolated, and can be grown outside the body on potato media. It is communicated to any who come in contact with the affected animals.

Symptoms in Man.—Incubation period 3–5 days. A pustular eruption breaking down into an ulcer occurs on the hands or face at the infected spot. The associated lymph-glands enlarge. The viscera and joints are infected, and the patient dies of acute septicæmia within about ten days.

A CHRONIC FORM may occur also. In this chronic abscesses affect the limbs, and suggest syphilis or tubercle.

Diagnosis is customarily made by the history of association with an infected horse. It may be assisted in doubtful cases by the injection of a sterilized culture of the *Bacillus mallei*, known as mallein. In case of glanders this is followed by a sharp febrile reaction.

Treatment.—Early and free excision of the local areas of infection.

CHAPTER V.

GONORRHOEA.**Infection by Gonococcus.—**

CHARACTERS OF ORGANISM (*see Fig. 1, p. 9*).—A diplococcus, kidney-shaped—Stains easily—Gram-negative—Occurs in pus or epithelial cells—Grows with difficulty on blood serum—Acids favour growth—Alkalis prevent it—It can penetrate intact mucous membrane—It prepares the way for ordinary pyogenic organisms.

SEAT OF INOCULATION.—Urethra (male or female)—Vagina—Rectum—Conjunctiva (especially in new-born).

Pathology.—The meatus and navicular fossa are lined by squamous epithelium, which is more resistant. Cocci invade the columnar epithelium of the penile urethra. A desquamation of the epithelium with leucocytic invasion results.

IN THE MORE SEVERE CASES the submucous tissue is invaded and becomes the seat of ulceration with deep infiltration by round cells. This forms a stricture later by its conversion into fibrous tissue.

IN THE Milder CASES the epithelium is regenerated in about six weeks, the columnar epithelium being replaced by stratified.

THE URETHRAL GLANDS undergo similar changes or become the seat of cystic suppuration.

Onset.—Symptoms of gonorrhœal urethritis appear 3–6 days after infection.

Course.—

1ST STAGE OR STAGE OF INVASION lasts 2–6 days. Smarting on micturition and itching at the meatus. The discharge is scanty and mucoid.

2ND OR ACUTE STAGE lasts 2–3 weeks. Thick, copious, purulent discharge. Pain during and after micturition may be severe.

3RD OR STAGE OF DECLINE lasts 2–3 weeks. Discharge is scanty, mucoid, or gelatinous. The lips of the meatus become glued together each morning.

TOTAL DURATION in an uncomplicated case 8–12 weeks. The case can only be regarded as cured when no filaments are passed in the morning urine.

SYMPTOMS.—Itching of meatus—Scalding micturition—Tenderness along course of urethra—Frequent micturition—Pain in perineum—Pain in back—Constipation—Some general malaise.

GLANDULAR ENLARGEMENT occurs in severe complicated cases, especially when ulceration exists. It usually affects the inguinal glands.

Varieties of Gonorrhœal Urethritis.—

1. ANTERIOR URETHRITIS (all cases begin as anterior urethritis).—In front of compressor urethræ muscle—Scalding micturition—First half of urine passed contains more shreds than second.
COMPLICATIONS. — Bubo — Balanitis — Chordee — Cowperitis — Stricture.
2. POSTERIOR URETHRITIS.—(Occurs in the second week or later)—Behind compressor urethræ—Frequency of micturition—Pain after micturition—Pain in perineum—Second half of urine contains more shreds than first half—Many casts of prostatic ducts are in urine.
COMPLICATIONS.—Cystitis — Prostatitis — Epididymitis — Vesiculitis.
3. GLEET.—Thin or gelatiniform discharge continuing for years after gonorrhœa.
CAUSES.—(a) Posterior urethritis where organisms are harboured in prostatic ducts; (b) Stricture of urethra; (c) Granular patches, i.e., ulcers of urethra, gout, alcoholism, venereum; (d) Repeated attacks.

Diagnosis of Genital Gonorrhœa.—**IN MALE.—**

- NON-SPECIFIC URETHRITIS.—Very rare—Organisms are Gram-positive—Clear up quickly.
FOREIGN BODY in urethra (by sound).
URETHRAL CHANCRE (by induration).
CHRONIC PURULENT CYSTITIS or PROSTATIC ABSCESS (by passing catheter and examining rectum).

IN FEMALE.—

- NON-SPECIFIC VAGINAL DISCHARGES are very common.
LEUCORRHŒA : Discharge comes from cervix uteri only.
PELVIC ABSCESS : Bimanual examination.
CARCINOMA, ETC. : Bimanual examination.

Specific nature of discharge can only be determined by a demonstration of the gonococci.

Treatment of Gonorrhœal Urethritis.—**IN ACUTE STAGE** (frequent scalding micturition, free purulent discharge).—

- REST. Copious fluid DIET, e.g., milk, barley-water.
FORBID meat, alcohol, tea, coffee, and sexual intercourse.
IRRIGATION TREATMENT.—This should be regarded as the most important routine method. Other methods of treatment by drugs and astringent lotions should only be employed when irrigation cannot be carried out.
Potassium permanganate solution (1 in 2000) is used. The apparatus consists in a receiver holding 2 pints, connected by a rubber tube 3 feet long to a blunt glass cannula. The latter is placed in the meatus after the

Treatment of Gonorrhœal Urethritis, *continued*.

patient has micturated, and at first the receiver is only raised about 2 feet, so as to fill the anterior urethra only. After about a week the pressure is raised to 3 feet, so as to force the compressor muscle and fill the bladder. Daily or twice daily irrigations are given, for four or five weeks.

Massage of prostate and vesiculæ is carried out after about two weeks, and is intended to empty these structures of infective material.

DRUGS.—Alkalis, e.g., potass. bicarb. gr. x—Potass. citras gr. xx.

Antispasmodics, e.g., tr. hyoscyami ℥x.

Diuretics, e.g., infus. buchu ʒj.

IN LATER STAGE (scalding ceased, discharge less).—

DRUGS.—Oleoresins: Ol. santali ℥x—Ol. copaibæ ℥x—Cubebæ ʒj.

VACCINES (see end of chapter).

URETHRAL INJECTIONS.—Zinc sulphate, silver nitrate, or protargol, gr. ij ad ʒj (strength may be gradually increased up to gr. v ad ʒj in each case, but pain should never be caused)—Potassii permanganas, 1–5000—Zinci sulphocarbolas gr. v ad ʒj.

Directions.—Use after micturition. Inject 2 to 4 drachms. Unless posterior urethritis is already present, compress urethra against symphysis pubis when giving injection. Retain for three minutes.

TREATMENT OF GLEET.—Ascertain the cause if possible.

If POSTERIOR URETHRITIS exists: Irrigations as above—Passage of large Lister's sound occasionally.

If STRICTURE exists: Dilate.

SOLUBLE PESSARIES made of hard wax impregnated with silver nitrate, protargol (5 gr. of each), or iodoform may be passed into the urethra at night and allowed slowly to dissolve.

Urethroscopy in Gonorrhœa.—

PRECAUTIONS.—The urethroscope should not be used as a routine procedure, and never in acute cases. Its chief value is in the diagnosis and treatment of chronic conditions associated with gleet. A preliminary injection of 1 drachm of 5 % solution of novocain should be given, and the meatus must be slit when it is too narrow to allow the passage of a moderate-sized tube.

PATHOLOGICAL CONDITIONS OBSERVABLE.—

Dark red colour, with tendency to hæmorrhage.

Pale surface when the mucous membrane is sclerosed or absent.

Inflamed urethral glands, which may be cystic and appear as minute yellow dots.

Polypoid projections, which represent exuberant granulations or hypertrophied tags of mucous membrane.

Granular patches, which represent chronic or healing ulcers when the mucous membrane has been destroyed.

TREATMENT THROUGH THE URETHROSCOPE.—

Granular patches, polypi, and inflamed areas may be touched with solid silver nitrate or the actual cautery.

Attempts to divide a stricture will probably be inefficient, if done through the urethroscope.

COMPLICATIONS.

By Extension.—

FROM ANTERIOR URETHRA.—

SECONDARY INFECTION by pyogenic organisms, e.g., *B. coli* and *Staphylococci*.

BALANITIS AND BALANOPOSTHITIS.—If phimosis, slit foreskin.

INGUINAL BUBO AND ABSCESS.—Open.

LACUNAR ABSCESS.—Penile fistula. Open from outside as early as possible.

CHORDEE.—Painful erections, usually at night. Penis is curved with the concavity downwards because the corpus spongiosum does not dilate proportionately to the corpora cavernosa. Treat by bromides and cold compresses.

WARTS on genitals, especially in women.—Touch with nitric acid, cauterize, or dust with calomel.

COWPERITIS.—Inflammation and suppuration of Cowper's glands, situated between the layers of the triangular ligament in the perineum. Usually one-sided. An abscess forms, which bursts externally by the side of the bulb, or rarely into the rectum. Treatment by fomentations and incision.

RETENTION OF URINE (spasmodic and congestive).—Treat by hip-baths, sedatives, and, if necessary, soft catheter.

STRICTURE.—Generally a late sequela.

GRANULAR ULCERS.

FROM POSTERIOR URETHRA.—

IN THE MALE.—

EPIDIDYMITIS (*see* Chap. L) usually occurs in the second or third week, or in the chronic stage. Urethral discharge ceases or diminishes on its occurrence. It may be caused by injudicious injections in the acute stage. Usually one-sided, but both sides may suffer successively. Bilateral affection generally leads to sterility.

TREATMENT.—Suspensory bandage, with lead and spirit lotion. In severe cases, rest in bed, with hot fomentations. Discontinue urethral injections.

CYSTITIS AND PROSTATITIS probably occur in all cases in a limited degree, certainly in all cases of posterior urethritis. Rarely these conditions are acute and suppurative,

Complications of Gonorrhœa, continued.

leading to prostatic abscess or diffuse urinary infection. These are generally cases of secondary infection, and occur in those who have an old stricture.

VESICULITIS, or inflammation of the vesiculæ seminales, probably occurs in most cases in conjunction with prostatitis and epididymitis. It may suppurate and cause a perineal or pelvic abscess. Rarely it causes blood-stained spermatic emissions.

IN THE FEMALE.—Cystitis—Labial abscess—Vaginitis—Endometritis—Salpingitis—Ovaritis—Peritonitis, generally localized in pelvis, and causing adhesions and sterility, sometimes general and acute.

IN CHILDREN.—In female infants vulvo-vaginitis occurs which may lead to peritonitis or arthritis and pyæmia. In some cases general infection begins with a gonorrhœal stomatitis.

By Transmission of Virus.—

PROCTITIS.—Tenesmus and discharge. Treat by irrigations and astringents.

RHINITIS.—Alkaline irrigations.

CONJUNCTIVITIS.—

In adult (unilateral).—Treat by Buller's shield over good eye—Irrigate with boracic acid—Instil *argenti nitras*, gr. v ad ʒj, quartis horis.—Cover with iced compresses.

In infants (ophthalmia neonatorum—bilateral). Often causes corneal ulcers, corneal opacities, perforation of the eye, blindness. Treat as above, cutting the external tarsal commissure if necessary for drainage.

By Absorption.—

General infection may arise in three ways: (1) By the absorption of the gonotoxin; (2) By the gonococcus; (3) By the pyogenic organisms of mixed infection—*Staphylococci*, *streptococci*, or *Bacillus coli*.

General infections are commonest in males as a complication of posterior urethritis. They occur late in the disease or in the second or third week of the acute stage.

GONORRHOËAL RHEUMATISM occurs in three forms:—

1. **ARTHRALGIA** without inflammation, but with myalgia and tenosynovitis.
2. **HYDRARTHROSIS.**—Painful effusions into the joints, especially the knees, associated with inflammation of peri-articular fibrous structures, e.g., tendon sheaths, ligaments, and bursæ.
3. **TRUE ARTHRITIS** of a sero-fibrinous or purulent type, the former being the most common. The onset is usually sub-acute and polyarticular, attacking the knees, ankles, and wrists most often. Often all affected joints recover

quickly except one, which remains inflamed. Fibrous ankylosis is a common result and bony ankylosis a rare one.

DIAGNOSIS.—

IN SUBACUTE RHEUMATISM.—There are many joints affected, migrating from one to another. The pain is acute, even in the absence of movement. Fever and sour sweats are present.

IN TUBERCULOUS JOINTS.—The onset is more gradual and there is less inflammation. It is limited to one joint.

AFFECTIONS OF MUSCLE, NERVE AND FIBROUS TISSUE.—With or independently of arthritis, various characteristic painful affections may occur.

PAIN IN THE HEEL AND SOLE OF THE FOOT from affection of the plantar fascia, ligaments, and tendons.

TENOSYNOVITIS AND BURSITIS, chiefly of the tendons of the ankle and wrist.

LUMBAGO, SCIATICA, NEURITIS.

GENERAL BLOOD INFECTIONS.—

SEPTICÆMIA AND PYÆMIA are very rare, and are then probably due to mixed infection.

ENDOCARDITIS AND PLEURISY are rare results of a gonococcal septicæmia.

TREATMENT of general infections.—

IN THE Milder Cases which are probably due to an absorption of toxins, the local condition should be energetically treated by injections, or through the urethroscope.

IN THE SEVERE AND CHRONIC CASES :—

VACCINE TREATMENT.—Injections of the gonococcal vaccines is the ideal treatment. The chief difficulty is that of preparing a suitable vaccine from the patient, because the gonococcus is so difficult to cultivate. Hence commercial preparations have generally to be used. The commercial preparations give almost as good results as the autogenous vaccine prepared from the patient.

SERUM TREATMENT.—Cases of arthritis have yielded to treatment with polyvalent antistreptococcus serum. This is owing to the fact that most of the worst cases are due to a mixed infection.

CHAPTER VI.

SYPHILIS.

Definition.—An infective venereal disease peculiar to human subjects but inoculable into animals.

Cause.—Infection by a specific spirochæte, the *Treponema pallidum*. Inoculation of any thin or abraded skin or mucous membrane.

Pathology.—

BACTERIOLOGY.—THE TREPONEMA PALLIDUM is now regarded as pathogenic. It is 4 to 20 μ in length and about $\frac{1}{4}$ μ wide, with flagella at either pole. The turns in the spiral are set very close, and number from 3 to 12. It is motile. Noguchi and others have cultivated the organism in the test-tube in pure state. It is best demonstrated in the primary sore by dark-ground illumination or by Burri's Indian-ink method.

DISTRIBUTION.—In all primary and secondary lesions and on the ulcerated surfaces. Lymph-glands, saliva, and urine. Ovary, placenta. Very numerous in still-born fœtus of syphilitic mothers. It is very scarce in gummata.

IMMUNITY.—Animals enjoy a NATURAL IMMUNITY against syphilis except in the case of the higher apes. Races in which syphilis has been common for many generations have acquired probably a RELATIVE IMMUNITY compared with virgin races, in which it assumes a very malignant form.

ACQUIRED IMMUNITY of a limited kind is conferred by an attack of syphilis. Within ten days of the appearance of the chancre other chancres may be produced by auto-inoculation. A second attack of syphilis may be acquired a few years after the first, showing that acquired immunity is not lasting. Patients with hereditary syphilis may acquire the disease after puberty.

WASSERMANN'S REACTION.—This is based on the supposition that the syphilitic toxin (antigen) caused the formation of an immune body of the order of 'amboceptors' that required the 'complement' to satisfy it. By mixing antigen (extract of syphilitic organs), amboceptor (syphilitic patient's serum), and complement (normal animal serum), the complement is fixed and cannot act with another antigen-amboceptor mixture, i.e., red blood-cells + anti-red-cell (hæmolytic serum from an animal). The second or hæmolytic mixture is not satisfied in the absence of free complement and cannot lysis red cells. Where the complement is not fixed by the first mixture, hæmolysis will occur. Thus the absence of hæmolysis indicates syphilis.

It has since been discovered that the reaction probably depends upon a perverted metabolism leading to the appearance of

certain colloidal bodies in the blood, and that any tissue will provide the antigen. Nevertheless there is still a considerable degree of specificity in the reaction.

TISSUE CHANGES.—In all cases there is a marked connective-tissue reaction, especially round the vessels.

IN CHANCER.—Large accumulation of lymphocytes and plasma cells. Some lymphangitis and endarteritis.

SECONDARY LESIONS.—Begin round the blood-vessels. There is a marked proliferation of the cells of the interpapillary processes of the epidermis.

GUMMATA.—A large mass of connective tissue and plasma cells are enclosed in a fibrous capsule—They undergo fibrosis or necrosis—There are some giant cells—The vessels show marked peri- and endarteritis, which probably accounts for the tendency to 'gummy' degeneration.

Sources of Infection.—

PRIMARY LESIONS.

SECONDARY LESIONS, especially condylomata.

INDIRECTLY, e.g., by pipes or drinking vessels used by those with lesions of mouth.

Stages of Syphilis.—

PRIMARY.—Local manifestation at the seat of inoculation. Absent in inherited syphilis.

SECONDARY.—General infection. Symptoms occur from one month to two years after inoculation. Lesions are superficial, symmetrical, and infective.

TERTIARY.—Lesions appear from second year onward. They consist of deep fibrocellular infiltrations of skin, bones, and viscera. They are not infective.

Incubation Period.—9 to 90 days.

Primary Lesion.—Hard or Hunterian chancre.

POSITION in order of frequency.

PENIS.—Glans or inner surface of prepuce—Outside skin—Meatus (common)—Urethra (very rare).

VULVA, vagina, or cervix.

Lips, anus, fingers, tongue, breast, abdomen, palate, or tonsils.

CHARACTERS OF HARD CHANCER.—Usually single—Appears 2 to 6 weeks after infection—Begins as a papule, which ulcerates later—Base is indurated like thin cartilage—Painless and without inflammation—Associated lymph-glands become 'shotty,' i.e., enlarged, but remaining painless and discrete and freely movable—Lymph-vessels between chancre and glands are often thickened and indurated.

It is followed by signs of specific syphilitic infection.

Always make a microscopic examination of the secretion. Presence of *Treponema pallidum* is a proof of the nature of a hard chancre.

Heals spontaneously.

Leaves little or no scar.

Primary Syphilis, continued.**DIAGNOSIS OF PRIMARY SYPHILIS.—**

SOFT CHANCRE.—Generally multiple—Appears 3-6 days after infection—Consists of a deep ulcer, which rapidly extends, and has sloughy base—Copious foul discharge—All signs of inflammation—Lymph-glands become inflamed and matted together and suppurate—No induration except inflammatory exudation—Will not heal without local treatment—Leaves well-marked scar—Is not followed by general infection.

CHANCRE OF MIXED INFECTION.—Presents signs of soft chancre at first—Later becomes indurated, and is followed by signs of secondary syphilis.

PRIMARY SYPHILIS AND GONORRHOEA.—Inflammatory complications of gonorrhoea may mask hard chancre—Indurated sore, followed by secondary syphilis.

CONCEALED CHANCRE.—Phimosis may conceal sore and produce a good deal of discharge—Bulbous bubo and later secondaries.

EPITHELIOMA.—Patient generally over 50—Longer history—Foul discharge—Warty growth with hard base, or ulcer with everted hard edges.

GUMMA OR 'RELAPSING CHANCRE.'—Associated with other tertiary lesions—Past history of primary and secondary syphilis—Inguinal glands not enlarged.

Psoriasis—Boil—Inflamed sebaceous glands—Eczema—Lupus.

COMPLICATION OF CHANCRE.—Phagedenic ulceration, especially when occurring under a tight prepuce.

TREATMENT OF PRIMARY SYPHILIS.—

If chancre is **DRY**: Rub with calomel ointment (30 per cent).

If chancre is **MOIST, ULCERATED, or SOFT**:

Lotio nigra or iodoform ʒj, boracic acid ad ʒj.

If chancre is **FOUL and RAPIDLY SPREADING**:

Pure carbolic acid, or acid nitrate of mercury.

If chancre is seen within a few days of its appearance, and is situated on the **PREPUCE**:

Excise by circumcision.

If chancre is concealed by **PHIMOSIS**:

Slit open prepuce.

Rigorous constitutional treatment as soon as diagnosis is certain.

Secondary Syphilis.—

APPEARS one to two months after chancre; two to three months after infection.

LASTS any time up to two years from infection.

GENERAL CHARACTERS OF SECONDARY LESIONS.—

Lesions affect skin, mucous membranes, lymph-glands, and eyes

—Copper colour—Polymorphic—Roughly symmetrical—Tend to spontaneous recovery—Without pain or irritation (secondary ulcers and fissures in mouth are painful).

GENERAL SYMPTOMS, which appear just before eruptions.—

ANÆMIA.

ACHING PAINS in bones and loins, worse at night.

GENERAL ENLARGEMENT OF THE LYMPHATIC GLANDS.—Most noticeable in posterior triangle of the neck and internal epitrochlear region.

A FEBRILE ATTACK, occasionally lasting a few days.

CEPHALALGIA (*see under* TERTIARY LESIONS).

SKIN ERUPTIONS OF SECONDARY SYPHILIS.—

1. ROSEOLA OR ERYTHEMA.—

Chiefly over trunk and flexor surfaces of limbs.

Patchy erythema fading on pressure.

Often leaves a patchy pigmentation, especially round the neck of women.

2. PAPULAR.—

All over the body. Very characteristic round forehead : 'corona veneris.'

a. SQUAMOUS, OR PSORIASIS : When papules are covered by scales of desquamating epithelium.

Squamous syphilides are very characteristic on the palms and soles. The scaly skin becomes heaped up and fissured.

b. CONDYLOMATA, or moist papules on the skin : Papules present on surfaces of skin which are kept habitually moist. Occur in order of frequency : Round anus — Scrotum — Perineum — Vulva — Lips — Umbilicus — Axillæ — Under breasts — Between toes — External ear.

These erythematous and papular eruptions are the only ones seen at all commonly. They are quite superficial, and leave no scar.

3. PUSTULES.—Resembling acne—When a number of pustules are close together, and break, and become covered by a large scab, it is termed ecthyma.

4. TUBERCULAR.—Deep layers of skin infiltrated—Ulcerate at one part and heal at another—Nose, forehead, scalp, buttocks.

5. BULLOUS.—Pemphigus—Large vesicles which suppurate, break, and are covered by a conical crust.

6. RUPIA.—Deep ulcers covered by limpet-shaped scabs.

Ecthyma, pemphigus, and rupia only occur late in very severe cases. Pemphigus is very characteristic of a severe form of congenital syphilis. They all leave scars which are characterized by being circular or gyrate in outline, thin, supple, and white.

Secondary Syphilis, continued.**AFFECTIONS OF THE HAIR AND NAILS.—****ALOPECIA.—**

1. General shedding of the hair and eyebrows during secondary stage—Yields to general treatment.
2. Patches of hair follicles are destroyed by deep ulceration, either secondary, tubercular, or tertiary—Incurable.

ONYCHIA.—Nails may become grooved, brittle, and broken in late secondary syphilis.

PERIONYCHIA.—Secondary ulceration round nail margin—May cause nails to be shed.

AFFECTIONS OF THE MUCOUS MEMBRANES OF THE MOUTH AND THROAT.—

SIMPLE CONGESTION of faucial mucous membrane.

BALD AREAS on tongue.

MUCOUS PATCHES, i.e., papules on mucous surface.

FISSURES, especially near angle of lips and edges of tongue.

ULCERS.—Superficial, covered by grey membrane on tonsils and fauces. They spread by narrow grey margin—the 'snail-track ulcers.'

ŒDEMA GLOTTIDIS occasionally complicates ulcerations at the back of the mouth and pharynx.

STOMATITIS DUE TO MERCURY.—Spongy bleeding gums—Profuse salivation—Fœtid breath—Ulcers with dark sloughy bases.

TREATMENT OF ORAL SECONDARY SYPHILIS.—

Avoid alcohol and tobacco.

Cleanse teeth carefully.

Gargles of alum or chlorate of potash.

Touch ulcers with chromic acid, gr. x ad ʒj.

SECONDARY AFFECTIONS OF THE EYES.—

IRITIS: Marked congestion, effusion, and adhesions—Pain slight.

CHOROIDITIS, RETINITIS (both rare).

LATE SECONDARY LESIONS—sometimes termed 'reminders'—sometimes forming intermediate or early tertiary signs.—

Peeling patches on palms and soles—'syphilitic psoriasis'.

Symmetrical painless epididymitis.

Synovitis, especially of knees.

Tertiary Syphilis.—

Lesions occur generally from second year after infection onward to an indefinite period.

Are non-infective.

Do not cause secondary lymph-gland enlargement.

Asymmetrical.

Affect the skin and deep tissues, especially Fibrous tissues—Bones—Viscera.

Tend to (a) Deep ulceration; or (b) Formation of a gumma; or (c) Fibrosis, i.e., hypertrophy of connective tissue and atrophy of parenchymatous tissue of affected organs.

No tendency to spontaneous cure.

Are generally amenable to iodides.

CHARACTERS OF A GUMMA.—Begins as collection of small round cells round blood-vessels in connective tissue. Blood-vessels are occluded by: (a) Endarteritis obliterans; (b) Pressure of small-celled infiltration. Central mass of cells dies and forms central 'gummy' core. Suppuration generally supervenes in superficial gummata. When skin or mucous membrane has burst, a 'wet wash-leather slough' is seen. Healing involves deep scarring with great contraction. Is generally painless and without signs of inflammation.

GUMMATOUS ULCER.—Formed by bursting of superficial gumma. History of preceding lump. Deeply punched-out edges. Surrounding tissues healthy. Base formed by 'wash-leather' slough. Granulations are firm, fibrous, and avascular. Outline is often formed by coalescing circles formed by fusion of small gummata. Painless. Scars left are thin and supple, with pale centre and pigmented margin.

TERTIARY LESIONS OF THE SKIN.—

GUMMATA, probably of subcutaneous origin—Commonest in region of knees—Loins—Sacrum and buttocks.

LUPOID ULCERATION.—Tuberculous masses in the skin coalesce, ulcerate at one part and heal at another—Serpiginous outline—Especially attacks face, but may occur anywhere—Copper-red colour when active—Supple white scar when healed.

TERTIARY LESIONS OF THE BONES.—

PERIOSTITIS.—Local, plastic, forming 'hard nodes'—Diffuse, combined with sclerosing osteitis, causing osteosclerosis (*Fig. 16*).

GUMMATA.—Subperiosteal, forming 'soft nodes'—Central, causing expansion with possible spontaneous fracture.

NECROSIS OR CRIES.—Probably resulting (a) from blood-supply being cut off by gummata or osteosclerosis, or (b) by secondary septic processes.

SPECIAL BONES AFFECTED.—

NASAL.—Necrosis, perforation of septum, sunken bridge.

HARD PALATE.—Perforation into the nasal cavities.

CRANIAL VAULT.—Especially frontal and parietal bones—One or more circular ulcers, or extensive 'worm-eaten' surface, black colour, necrosing fragments—Great thickening from osteosclerosis.

TIBIÆ, clavicles, femora, forearm bones.

STERNUM.

PHALANGES.—Especially proximal, causing syphilitic dactylitis—A local, hard, periosteal thickening occurs in shaft of bone—It causes shortening of the bone, but seldom involves the joint—Painless, and rapidly heals under iodides.

To be diagnosed from tuberculous dactylitis, which begins as central swelling at epiphysal end of bone—Is very painful—Involves joints—Is not influenced by iodides.

Tertiary Syphilis, continued.**LIPS, TONGUE, AND PHARYNX.—****LEUCOPLAKIA.**

FISSURES producing deep scarring and contraction.

GUMMATA.—Commonest in dorsum of tongue—May destroy soft palate or produce extensive adhesions or pharyngeal stenosis**LARYNX.—****HYPERPLASIA** of epiglottis or aryteno-epiglottidean folds.**GUMMATA** and gummatous ulceration.**PERICHONDRIITIS** and **NECROSIS** of epiglottis or arytenoids, or rarely cricoid and thyroid cartilages.

Sometimes complicated by œdema glottidis.

RECTUM.—**GUMMATA** surrounding bowel, ulcerating into its cavity—

Forming fistulæ—Producing commonest form of non-malignant stricture.

VISCERA.—In order of frequency: Testis, liver, spleen, heart, lungs, and any of the other viscera rarely.Two forms: **SOFTENING GUMMATA** and **FIBROUS THICKENING.****NERVOUS SYSTEM.—****CEPHALALGIA**, which may be marked in the late secondary or in the tertiary period, is characterized by intensity, persistence, and liability to nocturnal exacerbations.**BRAIN.**—Gummata (usually begin in bones or meninges)—

Obliteration of cerebral arteries—Aneurysm of cerebral arteries—Chronic meningitis—Paralysis of nerves, especially second, third, fourth, sixth—General paralysis of the insane.

SPINAL CORD.—Chronic meningitis—Subdural gummata—

Locomotor ataxy.

Congenital or Hereditary Syphilis is of several modes of origin, viz:—**PATERNAL.**—Infection accompanying the spermatozoon. About 40% of children thus infected are still-born or die in early infancy.**MATERNAL.**—The mother has syphilis before conception. The ovum is primarily infected. The child mortality is about 80%.**MIXED INFECTION.**—Both parents have syphilis. The child mortality is about 90%.**POST-CONCEPTIONAL SYPHILIS.**—The mother becomes infected after conception, and infection is transmitted through the placenta.**COLLES'S LAW.**—A healthy mother who begets a syphilitic child cannot be infected by the latter.**PROFETA'S LAW.**—A healthy child born of a syphilitic mother cannot be infected during infancy. This immunity does not apply to the acquisition of syphilis in adult life.

FŒTAL SYPHILIS.—Usually produces abortion and still-birth—The fœtus may be macerated—The placenta, liver, lungs, heart, and vessels are the seat of small-cell infiltration and are full of spirochætes.

INFANTILE SYPHILIS.—The child is syphilitic at birth—Marasmus and cachexia make it wizened and monkey-like—The spleen and liver are enlarged—Hydrocephalus or microcephaly may be present.

SYMPTOMS of congenital syphilis appear generally within three months of birth—Are those of secondary and tertiary disease, with following special features:—

EARLY RASH specially affects buttocks and genitals.

ULCERS round mouth, nares, and eyes leave radiating scars.

PEMPHIGUS is specially characteristic of a grave form. It may affect even the palms and soles.

GENERAL STOMATITIS, producing early loss of milk teeth and deformity of permanent.

OTITIS MEDIA, with permanent deafness.

ORCHITIS, producing a hard swelling of the testes on both sides, with atrophy later. It occurs within six months of birth; this and its bilateral character distinguish it from tuberculous orchitis of children.

PURULENT RHINITIS, producing 'snuffles,' loss of bridge to nose in later life (*Fig. 17*), caries of spongy bones, with ozæna.

HIGH PALATE (due to disease or stunted growth of nasal septum).

CRANIUM.—**Craniotabes**: Unossified spots in frontal or parietal bones. 'Parrot's nodes' over the frontal and parietal eminences, causing natiform or 'hot-cross-bun' skull.

Both these lesions may result from, or be intensified by, severe rickets.

LONG BONES, especially humerus, tibia, radius, and ulna.—**Epiphysitis**, producing thickening—Separation of epiphysis—'Pseudo-paralysis'—Suppuration in joints, the acute arthritis of infants.

There is an irregular proliferation and fatty degeneration of the cartilage cells, with defective ossification of the growing end of the bone.

JOINTS may be affected.—(1) Chronic synovitis; (2) Symmetrical osteo-arthritis; or (3) Suppuration secondary to epiphysitis.

LATE SYMPTOMS, occurring especially during puberty and adolescence:—

GUMMATOUS and **LUPOID** ulceration, most usually round nose, mouth, or knees.

INTERSTITIAL KERATITIS occurs usually from 5 to 20—Both eyes affected, but one at a time—Cornea is infiltrated with round cells—Ground-glass opacity—Marked circumcorneal zone of congestion—Vascular patches on cornea ('salmon patches')—Tends to recover—Leaves white patches.

Congenital Syphilis—Late Symptoms, *continued*.

DEAFNESS due to labyrinthine disease.

SCLEROSING OSTEOPERIOSTITIS or epiphysitis of long bones. May produce massive thickening, lengthening, or shortening. These lesions are often symmetrical.

AFFECTIONS OF TEETH (*Fig. 18*).—In permanent set in order of frequency: Central upper incisors, lateral upper incisors, lower incisors, first molars: show:—

Cutting edge or crown smaller than base, forming 'peg-top' teeth.

Semilunar notch in cutting edge ('Hutchinson's' teeth).

Upper central incisors are widely separated.

PARASYPHILITIC PHENOMENA.—Idiocy, meningitis, encephalitis, spastic paraplegia, hydrocephalus.

Treatment of Syphilis.—

PROPHYLACTIC TREATMENT.—

An inunction with calomel ointment (10 parts calomel, 20 parts lanolin) will prevent chancre formation if used within two hours of exposure to infection.

EXCISION OF A CHANCER has no influence in preventing the development of the disease.

MERCURY.—To be given as pulv. hydrargyri c. creta, or blue pill, after meals. Dose, about gr. ij three times a day for an adult. Combine with pulv. ipecac. co., if diarrhoea is caused.

Increase the dose until the gums become spongy as long as the disease is advancing.

When all signs have disappeared, give small dose (e.g., gr. j, t.d.s.) FOR TWO YEARS. (Three or four years are usually advisable altogether.)

Marriage is only safe four years after infection if treatment has been efficient, if no symptoms have been present for two years, and if the Wassermann reaction has been repeatedly negative.

PRECAUTIONS.—Avoid mercurial poisoning, as seen by stomatitis, diarrhoea, tremors, anæmia, or albuminuria. If these occur, discontinue for a time or give in some other manner.

Keep teeth carefully brushed.

Gargle mouth with alum or chlorate of potash.

OTHER METHODS OF ADMINISTRATION.—

IN MIXTURES, as liq. hydrarg. 3j.

AS AN INUNCTION, ung. hydrarg. 3ij, rubbed into thin parts of skin twice weekly. Ung. cinereum (mercury and lanolin aa, ol. spoliivæ q.s.): 3j, rubbed in for 15 minutes daily. For infants, ung. hydrarg. 3j diluted with two parts of ung. boracis, spread over inside of flannel binder.

The method of inunction is more rapid than the oral administration of mercury, and in adults is used for several weeks at a time.

By VAPORIZATION.—Calomel gr. xxx, vaporized over spirit lamp inside a blanket. Especially valuable when severe secondaries exist or when mercury by mouth causes stomatitis.

INTRAMUSCULAR INJECTIONS are given into the deep parts of the buttocks, using each side alternately. It is most useful when a rapid, powerful effect is desired, e.g., in cerebral lesions or when oral administration has failed.

THE INSOLUBLE PREPARATIONS are the most useful, because, being more slowly absorbed, they need be given only once a week.

The chief insoluble compounds used are grey oil, calomel, and salicylate of mercury.

GREY OIL (mercury $\bar{3}j$ by weight, lanolin $\bar{3}iv$ by weight, liquid paraffin with 2% carbolic acid ad $\bar{3}x$ by vol.). Mx contains gr. j mercury. $Mx-xv$ are given once a week.

CALOMEL gr. j in Mx paraffin given once a week for three or four weeks. It is the most powerful but most painful method.

THE SOLUBLE PREPARATIONS.—Biniodide $\frac{1}{2}$ – $\frac{3}{4}$ gr. daily, or perchloride $\frac{1}{2}$ gr. daily.

Mercurial treatment is more powerful if given intermittently, e.g., for two months at a time with one month's interval after the more active symptoms have disappeared. THREE OR FOUR YEARS' treatment is necessary, according to the nature of the case.

IODIDES.—Only necessary when tertiary symptoms are present. Act by causing small-cell infiltration to be absorbed.

Dose, gr. v, increased to gr. xxx t.d.s., or until action begins to be apparent. Give with ammonium carbonate gr. v, and plenty of water.

IODISM, or the irritative and toxic effects of iodides, consist in coryza and an acneiform eruption. Coryza is more likely to occur after small doses than after large.

Iodides should generally be given only for three or four weeks at a time.

RELATION OF MERCURY AND IODIDES.—

Mercury cures the syphilis.

Iodides resolve the gummata produced by syphilis, but they have no prophylactic power to prevent the further spread of the disease.

When the lesions of tertiary syphilis have been cured by iodides, a prolonged course of mercury should always be given.

Combine it with iodides in tertiary stages.

Give only iodides, for solitary gummata.

Congenital like acquired syphilis requires prolonged mercurial treatment, lasting for several years.

Treatment of Syphilis, *continued*.

ARSENIC.—The intravenous or intramuscular injection of one of the benzol compounds of arsenic is now regarded as the essential treatment. It is rapid in its action, but has failed to produce the lasting cure which was promised.

It may be given in the form of salvarsan, 0.3 to 0.6 grm. by intravenous injection; this drug is difficult to dissolve and requires that the patient should be kept under observation for some hours afterwards. Many modifications have been used to overcome these difficulties; neosalvarsan and novarsenobillon (N.A.B.) are the commonest; easy of solution, in a dose of 0.3 to 0.9 grm., they can be given as intravenous or intramuscular injections. (Galyl, sulpharsenol, silver-salvarsan are other arsenic preparations)

The use of these arsenic drugs should be an addition to, and not a substitute for, that of mercury, which still remains the most reliable cure of the disease.

TOXIC EFFECTS OF THE ARSENIC PREPARATIONS are various, the chief being dermatitis and jaundice. The liability to these is minimized by giving moderate doses at fairly long intervals.

COMPLETE COURSE OF TREATMENT.—No finality has been reached on this subject, but the following is a reasonable course: Three injections of neosalvarsan (0.6 to 0.9 grm.) at six-weekly intervals. Five or six mercurial injections at weekly intervals between the arsenic injections. Continue mercury by the mouth for twelve months. Repeat the arsenic and mercury injections for one or more six-weekly courses during two years if the Wassermann reaction is positive.

BISMUTH.—Given as intramuscular injections of the hydroxide (0.2 to 0.3 grm.). Chiefly used if mercury is badly tolerated. It may produce albuminuria or stomatitis.

FOR DEEP TERTIARY ULCERATION.—Scraping or actual cautery combined with drugs is of great assistance.

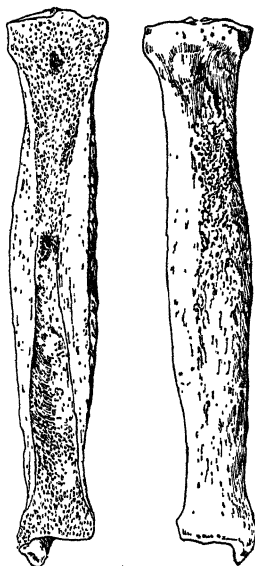


Fig. 16.—Syphilitic osteosclerosis of tibia. The whole bone is thickened and heavy, the marrow cavity being encroached on by increase of the cortex. A late tertiary manifestation.



Fig. 17.—Facies of congenital syphilis. Saddle-shaped bridge of nose. Low forehead. Scars at the angle of the mouth.

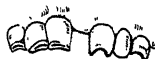


Fig. 18.—Teeth in congenital syphilis ('Hutchinson's' teeth).

CHAPTER VII.

TUBERCULOSIS AND ACTINOMYCOSIS.**TUBERCULOSIS.****Etiology.**—**PREDISPOSING CAUSES.**—

INHERITED SUSCEPTIBILITY, especially flat or narrow chests—
‘Sanguine and phlegmatic dispositions.’

CHILDREN and young adults are specially susceptible.

ATMOSPHERIC CONDITIONS.—Bad ventilation, overcrowding,
and dusty occupations are very potent causes.

ANY LOCAL WEAKENING of the tissue resistance.—Chronic
catarrhal conditions—Strains, sprains, especially of bones
and joints.

THE EXCITING CAUSE is the infection by the tubercle bacillus.

Tubercle Bacillus.— $3\ \mu$ long and $0.3\ \mu$ wide. Grows on blood
serum or glycerinated agar-agar. Grows very slowly, first as
small dots, then as wrinkled layer. Filamentous forms, often
branched, occur. Stains with difficulty, but retains the stain
against extraction with acids, i.e., is acid-fast. (See Fig. 3, p. 9.)

STAIN.—Hot carbol fuchsin (Ziehl) 5–10 minutes, wash, treat
with 25% nitric acid until decolorized; alcohol 60% half
minute. Counterstain with methylene blue.

Methods and Channels of Infection.—Through placental
circulation. Through respiratory organs by breathing tubercle-
laden dust. Through alimentary organs by eating tubercle-
infected food. Through injuries and abrasions of the skin or
mucous membranes. Through lymph-channels, i.e., tonsil, bowel.

Histology of a Tubercle (Fig. 19).—The grey military tubercle
is smallest tubercle visible to naked eye. It consists of a number
of submiliary tubercles or giant-celled systems. Each giant-cell
system consists of:—

CENTRALLY-PLACED GIANT CELL.—Measures 50–500 μ . Many
(20–50) nuclei massed near periphery. Bacilli are in the
cell opposite to nuclei. Protoplasm is always degenerate:
coagulation necrosis or caseation. Not to be confused with
macrophages and the giant cells of the bone marrow.

EPITHELIOID CELLS.—Placed in a zone round giant cells. Each
is two to three times as large as a white cell. Elongated, with
oval nucleus. Contain tubercle bacilli in or between them.
Most characteristic feature of tubercle.

LEUCOCYTES.—Form a peripheral zone. Contain no tubercle
bacilli. Result from inflammatory reaction round tubercle.

RETICULUM.—Fibrillar network between cellular elements.

Later Stages in the tuberculous process.—

CASEATION.—A number of miliary tubercles join to form a mass formed of all three kinds of cells. Blood-vessels being scanty or absent, necrosis takes place. This cell necrosis produces a cheesy structureless mass, known as caseous material. Caseation is best marked near the centre of the tubercle.

CICATRIZATION.—This is a process of repair. The granulation tissue surrounding the caseous centre is converted into fibrous tissue, and contracts. The liquid parts of the caseous material are absorbed, and the remainder forms a chalky mass—the so-called calcareous transformation.

LIQUEFACTION or SUPPURATION.—This is similar to ordinary suppuration, but it takes place without the usual signs of inflammation. A chronic abscess is formed.

PYOGENIC SUPPURATION.—In localities, e.g., the lung, where free access to the air occurs, or in any lesion where contamination from the skin or alimentary tract has taken place, a true pyogenic infection is set up which rapidly destroys the tissues and produces all the signs of pyogenic absorption.

Spread of Tuberculosis.—

BY LOCAL EXTENSION.—The disease spreads by direct contiguity from one organ to another, e.g., from the lung to the pleura or from a bone to the joint.

BY METASTATIC DEPOSITS.—Conveyed by blood, lymph, or secretions. Pulmonary tubercle often arises from that of the joints, tubercle of the bladder from that of the kidney, tuberculous meningitis from tubercle of the testis.

BY GENERAL BLOOD DISSEMINATION.—A general miliary tuberculosis arises from the development of tubercles round all the small vessels, especially in the serous membranes.

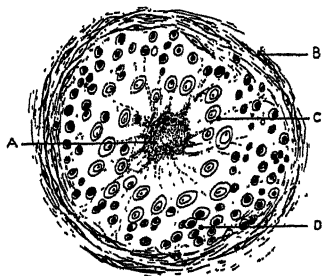


Fig. 19.—An early tubercle before caseation (diagrammatic). A, Central giant cell with peripheral nuclei; B, Zone of fibroblasts; C, Zone of endothelioid cells; D, Zone of lymphocytes.

Tuberculosis, continued.

Treatment.—As a general principle, this is a disease from which recovery will take place naturally, provided that the proper constitutional and local conditions be observed.

CONSTITUTIONAL CONDITIONS NECESSARY FOR RECOVERY.—

FRESH AIR, especially dry, bracing, open air. SUNLIGHT.
Abundant NITROGENOUS AND FAT FOOD.

LOCAL CONDITIONS NECESSARY FOR RECOVERY.—

REST for the diseased part, both physical and functional.
Hence the difficulty in treating tubercle in parts like the lung or bladder, which can never have complete physical or functional rest.

ABSENCE OF PYOGENIC INFECTION. When this infection has once occurred, natural cure is almost hopeless.

OPERATIVE TREATMENT is indicated generally when :—

The local focus is causing danger to life, e.g., tuberculous disease of the brain.

The local focus is likely to infect other important organs, e.g., tubercle of one kidney or of one testis.

The local focus affects an unimportant organ, e.g., tuberculous glands of the neck.

Tuberculous suppuration has occurred.

Pyogenic infection has occurred.

Other serious visceral disease is absent.

Rest and constitutional treatment have failed to cure.

INJECTION OF TUBERCULIN.—Various preparations from cultures of tubercle bacilli have been used for the treatment of the disease. The bacilli are killed by various thermal or mechanical means and an extract made from their remains; this forms tuberculin. The first dose varies from 0.0001 mgrm. to 0.0001 mgrm. according to the age of the patient, and is increased up to 0.001 mgrm., being given about once a week for a course of three months. Opinions differ much as to the value of these injections.

Diagnosis.—In obscure cases the following methods have been advised. They are not reliable, since even well-healed lesions, or some insignificant and quiescent glandular infections, will give the reaction. The reaction is related to anaphylaxis, and is not altogether devoid of danger.

INJECTIONS OF THE OLD TUBERCULIN.—Koch's tuberculin (0.005 c.c.) is injected hypodermically. A sharp reaction follows in a few hours—malaise, temperature of 101°–104° F., and local pain and swelling of the affected focus. This is not free from danger, and is now seldom used except in the case of cattle.

INJECTIONS OF THE NEW TUBERCULIN (T.R.) in doses of $\frac{1}{1000}$ to $\frac{1}{100}$ mgrm. This affects the opsonic index in tuberculous

cases. Thus: (1) A marked alteration in the opsonic index after tuberculin; (2) A variable opsonic index when taken on different occasions; (3) A considerable rise in the index after massage or exercise—all indicate tuberculosis.

CALMETTE'S OPHTHALMO-REACTION.—A drop of a watery preparation from the dried T.R. is instilled into the eye. Within six hours slight inflammation of the conjunctiva, especially at the inner canthus, indicates a positive diagnosis. It is not free from a slight risk of causing ulceration or severe conjunctivitis.

VON PIRQUET'S CUTANEOUS REACTION.—Four scarification marks are made upon the patient's skin, and into two of these the new tuberculin is rubbed. The scratches thus treated show a marked inflammatory reaction within two or three days as compared with the others. This reaction, on account of its simplicity and freedom from untoward results, is now used almost to the exclusion of the other methods.

ACTINOMYCOSIS.

Etiology.—It is caused by infection by the *Streptothrix actinomyces*.

THE ACTINOMYCES is an anaerobe and grows in cultures in the form of long branching filaments. In the tissues it is arranged in the form of radiating club-shaped masses, from which it was named the ray fungus (*Fig. 20*). These masses form granules in the pus which are visible to the naked eye.

IN CATTLE commonly affects tongue and jaw, forming chronic hard swellings, which break down to form suppurating sinuses.

Distribution in Man.—

THE UPPER OR LOWER JAW, tongue, or floor of the mouth is attacked most often, by direct infection by diseased corn.

THE LUNGS AND PLEURÆ are infected by inhaled particles, and chronic lesions like those of tubercle are caused. These may form an empyema, and the ribs and chest wall become the seat of chronic suppuration.

Any part of the alimentary tract, especially the CÆCUM, APPENDIX, and LIVER, may be infected by swallowed particles.

Pathological Anatomy.—At first a hard, indolent nodule is formed, e.g., in the jaw. Then the soft parts are involved in the nodular mass, which softens and breaks down, forming a multilocular abscess (*Fig. 21*). This discharges pus containing the characteristic granules. The whole process is marked by pronounced fibrosis, producing a dense scarring, which, while it deforms the part, tends to limit the diffusion of the disease, which is therefore very chronic in its course. Secondary septic infection of the diseased areas occurs sooner or later, and is the ultimate cause of death.

Treatment is by local excision and erosion where possible, and by large doses of potassium iodide in other situations. As a rule the visceral disease is surely though slowly fatal.

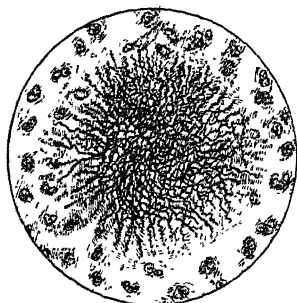


Fig. 20.—Mycelial filaments of actinomycosis surrounded by pus cells.



Fig. 21.—Actinomycosis. Dusky brawny thickening. Multiple sinuses. (*Bristol General Hospital, March, 1925.*)

CHAPTER VIII.

TUMOURS AND CYSTS.

Definition of Tumour.—An abnormal overgrowth of tissue which subserves no physiological function.

CLINICAL CLASSIFICATION.**I. Innocent Tumours.**—

- Encapsuled, or if diffuse they do not infiltrate.
- Do not infect the lymph-glands.
- Do not recur after complete removal.
- Do not disseminate.
- Do not endanger life, unless they mechanically interfere with some vital organ, or unless they lead to hæmorrhage or sepsis.
- Often multiple, and of different genera.

II. Malignant Tumours.—

- Are not encapsuled, but infiltrate the surrounding tissues.
- Sarcomata are often in a capsule in their early history, but inevitably break through the capsule before long.
- Infect adjacent lymph-glands.
- Tend to recur after removal.
- Become disseminated in distant organs.
- They inevitably destroy life.
- Primary growth is always single, except for rare cases of bilateral sarcomata.

THEORIES OF THE NATURE OF MALIGNANCY.—

1. COHNHEIM'S 'INCLUSION THEORY.'—Supposes the accidental inclusion of groups of embryonic cells in abnormal positions. These may be from cell 'rests,' e.g., accessory spleen, pancreas, or adrenal, or from the vestiges of structures which have only an embryonic existence, e.g., branchial clefts.
2. THEORY OF MICRO-ORGANISM.—
 - Facts in favour :—
 - a. The general similarity to bacterial diseases, the local origin, the dissemination, and cachexia.
 - b. The relation to some toxins of known bacterial origin, e.g., those of erysipelas.
 - c. The phenomena of Jensen's mouse cancer, the cells of which can be inoculated from one animal to another.
 - * Facts against :—
 - a. The most laborious research has failed to demonstrate an organism whose injection produces the disease.

Theories of the Nature of Malignant Tumours, *continued*.

- b. The fact that metastatic growths consist of the same cells as the primary shows an exuberant activity in the tissue cells, and not merely that they are invaded by a foreign organism.
- c. The great rarity of infection or contagion.
- 3. THE THEORY OF ALTERED CELL EQUILIBRIUM.—As the result of irritation the cells have the normal relations between function and reproduction altered so that they reproduce themselves indefinitely without regard to physiological needs. They destroy neighbouring cells and migrate to other organs, where they continue to proliferate, i.e., they become parasitic.

Facts in favour:—

- a. The phenomena of conflict between the cancer cells and those in their vicinity.
- b. The resemblances between the cancer cells and those whose chief object is reproduction, viz., the germinal cells, shown by the method of nucleus division.

HISTOLOGICAL CLASSIFICATION.**I. Connective-tissue Tumours.—****1. LIPOMA (*Fat Tumour*).—**

SUBCUTANEOUS.—May be sessile or pedunculated.

Lobulated and encapsuled, and painless—the common kind.

Multiple, painful—adiposis dolorosa.

Diffuse—in neck, axilla, groin.

SUBSEROUS.—In peritoneal cavity.—In hernial sacs—Exaggerated appendices epiploicæ.—In spermatic cord.

SUBMUCOUS.—Rare—Small—Conjunctiva, larynx, and any part of alimentary canal.

SUBSYNOVIAL.—Forming pedunculated masses protruding into joint cavities—'Lipoma arborescens.'

INTERMUSCULAR.—Comparatively common.

INTRAMUSCULAR.—Rare.

PERIOSTEAL.—Mixed with striped muscle fibres, generally congenital.

MENINGEAL.—Either intra- or extra-dural—Often associated with spina bifida—Often congenital.

2. CHONDROMA (*Cartilage Tumour*).—Often degenerate into mucus, or ossify—Long bones of limbs at epiphyseal junction—Especially from phalanges and in rickets—Parotid, submaxillary, and lachrymal glands.

ECCHONDROSIS.—Local outgrowth of articular cartilages, especially knee.

LOOSE CARTILAGES.—One variety is formed by chondrification of synovial fringes, which then become detached and float in joint.

3. OSTEOMA (*Bone Tumour*).—

COMPACT OR IVORY.—Dense and sessile. From frontal bones, especially in sinus or orbit—External auditory meatus—Angle of mandible.

- CANCELLOUS.—Tipped with cartilage until growth ceases. Generally from epiphysial lines of long bones.
- OTHER BONY OUTGROWTHS.—Subungual exostosis, generally from great toe—Ossified tendon insertions—Ossified muscles.
4. ODONTOMA (*Tumours developing from Teeth or Teeth Germs*).—
 EPITHELIAL.—Probably malignant. Epithelial columns with cystic dilatation embedded in fibrous tissue. Arise from enamel organ. (See Chap. XXIX.)
 FOLLICULAR.—A follicle containing a permanent tooth crown remains deep in the jaw and becomes distended like a cyst. (See Chap. XXIX.)
 RADICULAR.—Hard mass of dentine and cement attached to root of tooth.
5. FIBROMA (*Fibrous-tissue Tumour*).—
 SIMPLE.—Composed of masses of fibrous tissue. Gums (epulis)
 —Ovary—Uterus—Nerves.
 MOLLUSCUM FIBROSUM.—Overgrowth of skin and subcutaneous tissue in pendulous folds or pedunculated tumours. Often associated with multiple neuromata.
6. MYXOMA (*Mucoid Tumour*).—Very rare in pure form. Often present as degeneration product of other tumours. Nasal polyp (the common instance) is probably only cedematous granulation tissue.
7. GLIOMA.—Consists of delicate, branching, neuroglial cells. Brain—Spinal cord.
8. NEUROMA (*Nerve Tumour*).—
 TRUE.—
Multiplication of Actual Nerve Elements.—Rare.
Amputation or Traumatic Neuroma.
 FALSE.—Fibromata growing in nerve sheath.
Localized.—Painful nodule in subcutaneous nerve.
Diffuse.—Molluscum fibrosum and Recklinghausen's neuro-fibromatosis.
Plexiform.—Myxomatous thickening, generally on nerves of scalp.
9. ANGIOMA (*Tumour consisting of Blood-vessels*).—
 SIMPLE NÆVUS.—Skin, subcutaneous tissue, mucous membrane. Birth mark, or port-wine stain: Involves only capillaries. Telangiectasis: Arterioles, venules, and capillaries. Nævo-lipomata: Encapsuled masses of fat and nævoid tissues.
 CAVERNOUS NÆVUS.—Skin, mucous membrane, surface of liver. Tissue similar to erectile tissue, containing large blood spaces.
 PLEXIFORM ANGIOMA.—Subcutaneous tissue, especially scalp or limbs. A superficial mass of tortuous veins is a marked feature, and hypertrophy of the tissues is common.
 Cirroid aneurysm—Aneurysm by anastomosis, etc.

Connective-tissue Tumours, *continued*.

10. LYMPHANGIOMA (*Tumours consisting of Lymph-vessels*).—
SIMPLE OR CAVERNOUS—Dilated lymphatics. In skin, mucous membrane, especially tongue or lower lip.
LYMPHATIC CYST.—Cystic hygroma—Usually congenital—Neck, axilla, or groin
11. MYOMA.—Consists of unstriped muscle and connective tissue. Occurs in uterus, bladder, cesophagus, and intestine. Hard or soft, according to proportion of fibrous tissue to muscle. Generally multiple and encapsuled. Tends to degeneration and other changes : Calcification—Myxomatous degeneration—Gangrene—Sarcomatous growth.
12. MYELOMA or Benign Giant-cell Sarcoma (*Marrow Tumour*).—Consists of red marrow tissue, i.e., many multinuclear cells embedded in mass of round and spindle cells. Very vascular, even pulsating. Occurs in ends of long bones (especially head of tibia and lower end of radius), in mandible or maxilla, or as an epulis. Expands outer layer of bone to thin shell. Does not disseminate nor affect lymph-glands. Does not recur if removed locally. Myelomatosis may occur, in which the myelomata are multiple and may be present in any tissue of the body.
13. SARCOMA (*Malignant Connective-tissue Tumour*).—Occurs in any tissue of the body, bones being specially liable. Femur, tibia, scapula, and innominate are most frequently affected. Very vascular. May cause a bruit. Liable to infect blood-stream by venous dissemination, and thus cause metastatic growths, most commonly in lungs and liver. Lymph-vessels are absent or scarce. Many varieties never infect lymph-glands. But sarcoma of the mamma and melanoma always infect the glands. There is a tendency to the formation of cartilage, bone, and rarely striated muscle spindles (the latter in the kidney, testis, and cervix uteri). Degenerative processes, hæmorrhagic or myxomatous, common. Often occur in childhood or infancy. In the case of the eye, kidney, ovary, and adrenal in infancy, the sarcoma may be bilateral. Consists of immature connective tissue. Differs from innocent connective-tissue tumour by preponderance of cellular over intercellular elements and the immature character of the cells. Differs from malignant epithelial tumour by fact that the cells are not arranged in groups, and that they are separated by intercellular tissue and blood-vessels.

VARIETIES.—

- a. ROUND-CELLED SARCOMA.—Universal distribution in tissues, and occurs at any age.
Intercellular substance reduced to a minimum.

- b. **LYMPHOSARCOMA.**—Tissue with structure of lymph-gland—definite intercellular network enclosing small round cells.
- c. **SPINDLE-CELLED SARCOMA** (including the so-called 'mixed-celled sarcoma').—Cells are fusiform, or oat-shaped. In sections some are round, others elongated.
Intercellular tissue often develops into fibrous tissue, cartilage, muscle, or bone.
Occurs in periosteum and in glands, e.g., ovary, testis, mamma, kidney, parotid.
- d. **ALVEOLAR SARCOMA.**—Cells arranged in alveoli like those of a carcinoma.
Originate in skin in hairy moles.
- e. **MELANOMA.**—Contains masses of brown pigment between and in the cells—Cells vary in size and shape—often of an alveolar type.
The urine may contain the pigment and blackens on exposure or after oxidation.
Originates in skin (moles), nail matrix, vulva, anus, palate, and uveal tract. At any age.
Intensely malignant. Infects lymph-glands and rapidly disseminates.
- f. **CHLOROMA.**—A lymphosarcoma of grass-green colour.
Occurs in children and young adults, growing on the skull bones chiefly. It is intensely malignant.

TREATMENT.—

FREE AND EARLY REMOVAL of the affected part is the rule. In the case of round-cell sarcoma, melanoma, and sarcoma of the femur it is almost hopeless. In the case of myeloid sarcoma only local removal is necessary.

INJECTION OF COLEY'S FLUID.—An attack of erysipelas has been observed to check the growth of sarcomata. The mixed toxins of streptococcus of erysipelas and *Bacillus prodigiosus* are injected—if possible into the tumour—beginning with small doses and increasing until a rise of temperature is produced. Repeated daily or on alternate days for at least four weeks. If no improvement occurs in this time it is discontinued. If the case improves, continue for a year. Used also as a prophylactic against recurrence after operation. Best results have been with spindle-celled sarcoma.

14. **ENDOTHELIOMA** is a sarcoma which arises from endothelial tissues, usually in a gland, e.g., the parotid or testis. It includes a quantity of glandular tissue, together with cartilage, and is very prone to myxomatous change. Also develops in the serous membranes—pleura and peritoneum—and from the 'carotid gland' in the neck. The arrangement of the endothelium in branching columns gives a strong resemblance to an epithelioma.

Connective-tissue Tumours—Endothelioma, *continued*.

ORIGIN may be from endothelium :—

Lining lymphatic clefts or spaces,

Lining blood- or lymph-vessels, or

Lining lymph-vessels in sheath of blood-vessels (perithelioma.)

MENINGIOMA, sometimes termed a PSAMMOMA or ENDOTHELIOMA, arises from the endothelial cells of the arachnoid villi.

Cells are arranged in whorls. Central portions become calcified.

15. ADRENAL TUMOUR OR HYPERNEPHROMA.—Sarcoma originating either in the adrenal gland or in accessory adrenal glands, which may be situated beneath renal capsule, beneath hepatic capsule, or in the pelvis.

Imitate the structure of the adrenal zona fasciculata.

Often occur in infants, and are then generally bilateral.

II. Epithelial Tumours.—

1. PAPILLOMA.—Consists of a central axis of vascular fibrous tissue surrounded by layer of epithelium. Epithelium never dips down into the tissue below the basement membrane.

WARTS.—Occur on the skin, tongue, or larynx.

Single and stationary : May develop into horn, sarcoma, or epithelioma.

Multiple : Possibly infective—Especially in children—Often vanish rapidly.

Genital : Result from vaginal or urethral discharges.

VILLOUS PAPILLOMA.—Delicate branching filaments occur in bladder or renal pelvis, and choroid plexuses of brain.

INTRACYSTIC PAPILLOMA.—Occurs in ducts of glands, e.g., mamma or ovary.

HORNS may arise in four ways :—

a. By keratinization of a wart, especially on glans penis.

b. By keratinization of the contents of a sebaceous cyst.

c. By growth from the cicatrix of a burn.

d. By overgrowth of a nail, especially the big-toe nail.

2. EPITHELIOMA.—Consists of downward growing columns of stratified epithelial cells, simple or branching.

Begins as a wart, ulcer, or fissure.

Occurs in any surface covered by stratified epithelium—Mouth, tongue, œsophagus, larynx, anus, penis, scrotum, vulva, vagina, cervix—Skin, especially at site of warts, scars, or chronic ulcers—Bladder.

Columns of down-growing epithelium often become horny, forming cell-nests or epithelial pearls.

Rapidly invades lymph-glands, and invades neighbouring structures. Visceral metastases are rare.

3. **ADENOMA.**—Innocent tumour. Consists of gland tissue unconnected with ducts. Often encapsuled.
May occur in any gland. Common in mamma, ovary, parotid, thyroid, sebaceous glands, and uterus.
Alveoli, having no duct outlets, are very often cystic.
When growing from a mucous surface they are pedunculated and called polypi. Common in rectum and uterus.
Usually occur in adolescence.
4. **CARCINOMA.**—Malignant tumour. Consists of mass of gland tissue of an abnormal type. Chief points are :—
Arise in situations where the tissues are exposed to constant irritation, e.g., the tongue of clay-pipe smokers, on the skin of those who work with tar, paraffin, soot, or X rays. Also in the site of ulcers or scars, e.g., in stomach, cervix uteri, or lupus scars.
Glandular alveoli penetrate below basement membrane.
Alveoli may consist of solid columns of cells instead of hollow tubes.

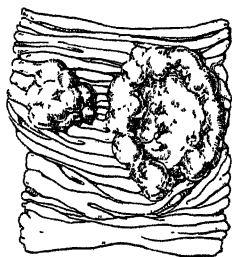


Fig. 22.—Malignant ulcer of rectum.



Fig. 24.—Rodent ulcer.

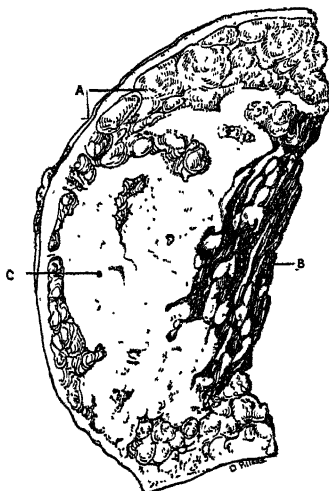


Fig. 23.—Scirrhus cancer of breast invading skin and muscle. A, Breast tissue; B, Muscle; C, New growth.

Epithelial Tumours—Carcinoma, *continued*.

Irregular and disorderly proliferation of gland tissue.

The fibrous tissue in the neighbourhood undergoes a marked proliferation which is of the nature of a hostile reaction.

They are rich in lymphatics and poor in blood-vessels.

Very liable to ulceration, necrosis, or colloid degeneration.

Quickly infect lymph-glands—Rapidly disseminate.

Local infectivity is shown by growth of a second tumour in a place in contact with the first, e.g., from one labium to the opposite, from an ulcerating cancer of the breast to the skin of the arm. These occurrences are very rare. In operations where the cancer is cut into, the stitch holes may be the seat of recurrent growths.

Very rare in young—Commonest at 45-65.

VARIETIES.—

- a. COLUMNAR-CELLED or ACINOUS.—Arising from and mimicking a tubular gland structure.

Commonest in alimentary canal—œsophagus, stomach, colon, and rectum (*Fig. 22*)—uterus.

- b. SPHEROIDAL-CELLED.—Solid columns of spheroidal cells.

Commonest in breast (*Fig. 23*) and stomach.

SCIRRHUS.—A spheroidal-celled carcinoma in which a large proportion of connective tissue occurs, forming a very hard growth. Especially common in old patients.

ENCEPHALOID CANCER.—A carcinoma containing a minimum of connective tissue, forming very soft growths.

Usually spheroidal-celled. Especially common in young patients.

- c. RODENT ULCER or sebaceous carcinoma (*Fig. 24*).

Probably starts in the cells of sebaceous glands—Begins as a nodule on the skin—Ulcerates after several years. Slowly destroys every tissue it meets, e.g., eyeball, bones of face.

Edges show but little heaping up—Often covered by a scab, but never heals by cicatrix.

Never infects lymph-glands. Never disseminates.

Commonly occurs on nose, eyelids, orbital angles, or cheek.

May occur on neck, or rarely on trunk.

Common in the aged, rare before 40.

Seldom recurs after complete removal.

Microscopically, it contains no 'prickle' cells like an epithelioma, it never has cell-nests or any keratinization, and its cells are smaller than those of an epithelioma.

- * 5. CHORION-EPITHELIOMA or deciduoma malignum.—

Generally occurs in the uterus after a miscarriage.

Consists of tissue like that of the early foetal chorionic tissue, viz.: Multinucleated masses of protoplasm, the syncytium, and many spindle cells like those of Langhans' layer.

Exactly similar tumours occur in the testis ; therefore they are, strictly speaking, teratomata.

Leads to early multiple visceral metastatic growths, especially in the lungs.

The Treatment of Cancer.—

EARLY REMOVAL, with a good margin of healthy tissue and with the associated lymphatic area, is imperative in all possible cases.

X RAYS.—For superficial growths, e.g., rodent ulcer or recurrent nodules in the skin after breast cancer, X rays are often curative. For certain deep growths, lymphosarcoma, lymphadenoma, or even metastases of carcinoma in bones, deep X rays are efficacious, causing arrest or disappearance of the tumour and alleviation of symptoms.

RADIUM.—Is used as a potent source of radio-activity. Radium gives off three sets of rays: α rays with no penetrating power; β rays with little penetration but with destructive effect on the tissues (if unscreened radium is used, it will by reason of the β rays act as a caustic and make a deep burn very slow to heal); γ rays with great penetrating power and with a selective action on germinating cells, especially those of malignant growths. A solution of radium salt gives off a radio-active gas called radon, the potency of which lasts only for about one week.

FORMS OF APPLICATION.—Radium is employed in four ways:

- (1) *Flat applicators* containing about 5 to 20 mgrm.;
- (2) *Platinum needles* containing 1 to 5 mgrm. in the form of one of the salts, usually the sulphate, the platinum case being about 0.6 mm. thick so as to screen off the β rays;
- (3) *Radon seeds*—glass or metal capsules containing radium emanation, each containing about 1 to 5 units of emanation (this unit is called a millicurie and is $\frac{1}{1000}$ part of the gas which would be given off from 1 grm. of radium);
- (4) *A bomb*—a large quantity of radium, 4 to 5 grm., in a heavy metal container, through a screened window of which the rays can be directed on to the patient from a distance of 1 to 6 ft.

INDICATIONS FOR VARIOUS APPLICATIONS.—In most cases, the method of choice is *interstitial radiation*, by which needles containing 1 to 3 mgrm. are buried in the tissues in and around the growth so that about 1 mgrm. of radium is allotted to each cubic centimetre of tissue; these are left in place for about 6 to 10 days. *Surface radiation* is by the flat applicators heavily screened by lead, or by incorporating a series of needles in rubber or wax so as to act at about 1 or 2 cm. away from the skin; thus the whole of the front of the neck or the chest may be radiated so as to act upon glands or possible fugitive malignant cells. *Radon seeds* are used for inaccessible places, e.g., the brain; they are left permanently in place. *The bomb* is used in order to

Treatment of Cancer—Radium, *continued*.

irradiate a wide area of deep lymphatics, e.g., in the chest or pelvis after a primary growth in the breast or uterus has been treated.

INDICATIONS AND RESULTS OF RADIUM TREATMENT OF MALIGNANT DISEASE.—It is impossible as yet to estimate the proper value of radium, because there has not been time enough to wait for late results. Moderate opinion would accept the following estimate. In suitable cases, radium has the same effect as excision of a primary growth, with the advantage of avoiding a mutilating and sometimes dangerous operation. It can often arrest for a long time an inoperable growth. It is doubtful whether it can prevent or cure lymphatic spread.

Superficial Growths such as Rodent Ulcer or Secondary Skin Nodules after Cancer of the Breast.—Radium is effective.

But in rodent ulcer, if the effect is not immediate and complete, it is better to excise.

Mouth.—Epithelioma of the tongue or lips, and some cases of laryngeal growth, should be treated by interstitial radiation, followed by excision of the glandular areas. The growth disappears, mutilation is avoided, and mobility of the parts is restored. There is no evidence that late results are better than after excision.

Cervix Uteri.—Radium has given such good results that it has been adopted as the routine treatment by many surgeons. It avoids the ordeal and high mortality of the radical Wertheim operation, but it is too soon to say whether the late results are as good.

Breast.—Radium is indicated in all inoperable cases or those with involvement of skin and glands, and in patients who refuse operation. Only a few enthusiasts use it for early cases, where radical operation gives such good results.

Brain, Rectum, Bladder.—In these the method is under trial and is a hopeful alternative to doing nothing in inoperable cases, but not justified in those where the growth can be removed.

Bone.—Radium is useless, because it cannot effectively penetrate the bone tissue without causing extensive necrosis.

LEAD SELENIDE.—Both lead and selenium in colloidal solution have given some hopeful results. A. T. Todd,* using a colloidal solution of lead selenide injected into the veins, has had remarkable success in dealing with otherwise hopeless cases.

CATAPHORESIS, i.e., the driving into superficial tissues of drugs, e.g., zinc, iodine, etc., by weak electric currents, is said to be curative of small superficial epitheliomata, as well as rodent ulcers.

* *Lancet*, 1930, ii, 389.

THYROID, PANCREATIC, AND SMALL INTESTINE EXTRACTS have been given for various theoretical reasons, without much practical result.

III. **Dermoids.**—Skin or mucous-membrane tumours occurring in situations normally devoid of these structures.

SEQUESTRATION DERMoids.—Occur in masses of embryonic epiblast which have become sequestered in the deep tissues during development, especially along lines of fusion of epiblastic folds.

SITUATION.—Mid-line of body, except from tip of nose to occiput.

In facial and branchial clefts, inner and outer canthus of eye, sides of nose, angles of mouth, pinna of ear.

Over scalp in the cranium and root of nose they are caused by patches of epithelium being cut off by inward growth of membranous bones from the surface skin. Hence these varieties either lie in a hollow of the bone or else underlie the bone altogether.

IMPLANTATION CYSTS.—Found under the skin or conjunctiva when pieces of epithelium have been buried by injury.

TUBULO-DERMoids.—Arise in a persistent foetal duct.

LINGUAL.—Upper part of the thyroglossal duct.

THYROGLOSSAL.—Anywhere in mid-line from hyoid to sternum, from persistence or diverticulum of thyroglossal duct.

BRANCHIAL.—Cysts beneath the deep fascia of neck arising from branchial clefts.

RECTAL.—From post-anal gut. They may project into rectum as a polypus. They may lie between rectum and sacrum. They may bulge out behind as sacrococcygeal tumour.

URACHAL.

OVARIAN DERMoids.—Probably arise from an ovum by an abnormal reproductive development, possibly by parthenogenesis or by inclusion of a fertilized ovum within the body of the foetus.

Contain skin and glandular structures of the utmost complexity : hair (often very long) ; glands (sebaceous, sweat, mammary) ; skin appendages (horns, nails, epithelial pearls) ; bone and teeth.

Somewhat similar tumours occur in testis.

MOLES.—Dermoid patches. Hairy, pigmented, raised areas of skin or conjunctiva.

Base consists of large cells arranged in an alveolar fashion.

Often form starting-place of melanotic tumours.

IV. **Teratoma.**—A conglomerate mass of foetal tissues and organs. Represents a 'parasitic' foetus, that is, an incompletely separated and ill-developed twin.

Or may possibly arise from activity of an undifferentiated reproductive cell.

Commonest in sacrococcygeal region.

Ovarian and testicular dermoids may be of this nature.

CYSTS.

Of Embryonic Origin.—DERMOID CYSTS (*see above*).DENTAL CYSTS (*see ODONTOMA*).

TUBULO-CYSTS.—Dilatation of functionless ducts.

CYSTS OF THE URACHUS, CYSTS OF VITELLO-INTESTINAL DUCT.

CYSTIC DISEASE OF TESTIS and cyst of the epididymis arise from Wolffian gland and duct.

PAROOPHORITIC CYSTS, PAROVARIAN CYSTS, and PARAVAGINAL CYSTS arise from Wolffian tubules and duct in female.

CONGENITAL AND INFANTILE HYDROCELES.

Distention Cysts.—Formed by the distention of closed cavities.

GLANDULAR.—Thyroid—Pituitary—Some ovarian.

NEW GROWTHS, especially adenomata.—Adenoma of breast—Ovarian adenoma.

PERITONEAL.—HYDROCELE—Tunica vaginalis—Canal of Nuck—Funicular process—Ovarian—Hydrocele of hernial sac.

SYNOVIAL.—

BURSÆ.—Distention of normally-placed bursæ, e.g., prepatellar

—Bursæ connected with joints, so-called 'Baker's' cysts—

Bursæ of new formation, e.g., that between hyoid bone and thyroid cartilage.

GANGLIA.—Hernia of synovial membrane through a tendon sheath.

VASCULAR SPACES or extravasation.—

BLOOD CYSTS.—Hæmatocele—Breaking down of vascular new growths—Arachnoid cyst.

LYMPH CYSTS.—Hygroma—'Hydrocele' of neck—'Serous' cysts of mamma, axilla, or groin.

NEURAL CYSTS.—

Hydrocephalus: distention of ventricles—Syringomyelia: distention of central canal of spinal cord—Meningocele, etc.: spina bifida.

Retention Cysts.—Formed by a blocking of gland ducts.

Galactocele—Cystic disease of breast—Ranula—Dacryops

—Pancreatic cyst—Hydrometra—Hydronephrosis—Hydro-salpinx—Hydrocholocyst.

Parasitic Cysts.—

ECHINOCOCCUS (hydatid cysts).

CYSTICERCUS.

HYDATID CYSTS.—

DISTRIBUTION.—In Australia and the Arctic regions, where dogs are very intimately associated with human beings, the disease is common; elsewhere it is rare.

THE PARASITE is a small tape-worm, the *Tænia echinococcus*, the adult form inhabiting the intestine of dogs and other

animals, and the embryonic form growing in human tissues inside cysts.

LIFE HISTORY.—The head consists of a worm half an inch long, with four segments. The head has four small suckers and a row of hooklets. The posterior segment is the largest and is filled with the genital organs. From these the ova are discharged, and are then, by contamination with food, water, or uncooked vegetables, conveyed to the human host. The embryo develops in the stomach or intestine, and has four suckers and a set of hooklets. It burrows its way into the blood-stream, and is deposited in the liver or any other tissue. Here it forms a hydatid cyst.

THE HYDATID CYST consists of two layers: an ectocyst, which is firm and chitinous, and an endocyst, which is protoplasmic. The tissues of the host form a firm fibrous layer or capsule outside the cyst. The endocyst is formed by germinal protoplasm, from which generally grow: (1) Numerous daughter cysts; (2) Brood cysts containing other embryos in their interior; (3) Solitary heads of mature worms known as scolices. The fluid in the cyst is of specific gravity 1007, with a trace of albumin, some sodium chloride, and a quantity of free hooklets, by which the nature of the fluid is commonly recognized.

VARIATIONS.—If the cyst contains no brood cysts, daughter cysts, or scolices, it is known as barren, or an acephalocyst. Sometimes the main cyst disappears and a collection of daughter cysts and scolices lie free in the tissues. This is the common condition in hydatid disease of bones, and is known as exogenous development.

SITUATION OF CYSTS.—Liver, brain, kidneys, bone, or any other tissue, the first named being much the commonest.

RESULTS.—

1. Simple growth, causing pressure symptoms.
2. Rupture into a serous cavity, causing toxæmia and marked urticaria. The scattered scolices may embed themselves and grow in the peritoneum or pleura.
3. Death of the parasite. The cyst then shrivels up, and may eventually become caseous or calcified.
4. Suppuration, with all the possible eventualities of an abscess, e.g., septic absorption, rupture, etc.

CYSTICERCUS CELLULOSÆ is the intermediate or embryonic form of the common tape-worm or *tænia solium*. The cysticercus stage is generally found in the flesh of pigs, and the adult *tænia* in the gut of man. But sometimes, especially in Germany, the cysticercus develops in human tissues as one or many cysts of varying size. The commonest situation is the brain or eye, but occasionally it may form a cyst the size of a pea under the skin. In the brain they are eventually fatal. They cause destruction of the eye. From the skin they should be excised.

CHAPTER IX.

WOUNDS.

Definition.—A forcible solution of continuity of the soft tissues.

Contusions.—Skin is not broken.

ECCHYMOSIS OR BRUISING produced by rupture of small blood-vessels.

If blood is poured out in some quantity, and enclosed by fascia or membranes, a

HÆMATOMA results. Fluid at first—Becomes hard when coagulation occurs—This hardness begins as a peripheral ring—Results in: absorption, organization into a fibroid mass, serous cyst (e.g., arachnoid cyst), or suppuration.

TREATMENT.—Evaporating lotion, or hot fomentations. Firm pressure. Aseptic incision as a last resort in very exceptional cases.

Incised Wounds.—Clean cut, with little or no bruising. Wide gaping of lips. Free hæmorrhage.

TREATMENT.—

1. **ARREST HÆMORRHAGE.**
2. **RENDER PARTS AS ASEPTIC** as possible.
3. Sew margins together.
4. **DRAIN** only if:—Deep infection cannot be got rid of—Deep bleeding cannot be arrested—Pressure cannot be applied (e.g., neck)—Wound communicates with deep cavity where extravasation exists, e.g., wounds of loin.
5. **DRESS**, with efficient application of
6. **PRESSURE.**
7. **ATTEND TO THE GENERAL HEALTH.**

FAILURE TO UNITE by first intention, due to:—

1. **INEFFICIENT ARREST OF HÆMORRHAGE.**
2. **INEFFICIENT ASEPSIS**, or foreign body in wound.
3. **INEFFICIENT suturing.**
4. **ABSENCE OF DRAIN** in cases mentioned.
5. **INEFFICIENT DRESSING**, i.e., infection after sewing up.
6. **GENERAL DISEASE.**
7. **CONSTITUTIONAL DEBILITY.**

IF INFECTION HAS OCCURRED it is indicated by:—

Rise of temperature, rigor, etc.—Local pain and throbbing—Signs of inflammation round wound.

TREAT by: Opening freely—Washing out with peroxide of hydrogen—Freely draining.

DEATH MAY OCCUR from shock, hæmorrhage, or septic infection.

Lacerated and Contused Wounds.—

Produced by a blunt instrument, which tears the soft parts.

Wound is associated with injury to the surrounding parts.

Hæmorrhage is slight, or absent, as vessels have been torn rather than cut.

Edges torn and bruised, with little or no gaping.

Parts may be cut off from their blood-supply by—original injury, inflammatory reaction (thrombosis), or pressure of bandages.

Hence SLOUGHING and GANGRENE are common occurrences.

IF ASEPTIC it may heal by first intention if edges can be brought together, but generally some sloughs have to be absorbed, or cast off, and healing is by granulation.

IF SEPTIC—as the majority of such cases are—acute inflammation, resulting in suppuration, sloughing, or gangrene, attacks parts round the wound.

This secondary sloughing is responsible for the loss of much more tissue than is the original injury in most cases.

After sloughs have separated, wounds heal by granulation.

DEATH may occur from shock or septic infection.

TREATMENT.—

Antitetanic serum—prophylactic dose of 500 units.

Clean up (under anæsthetic if necessary). Trim off ragged edges and remove parts likely to slough.

Leave wound open, and pack or suture, leaving many gaps for drainage.

If septic inflammation occurs—Hot fomentations until sloughs have separated or suppuration has ceased.

If wound is very severe and involves a limb:—

AMPUTATION WILL BE CALLED FOR: If limb has been torn off—If part is quite disorganized—If gangrene occurs, or is imminent—If severe septic symptoms occur—In severe crushes of the foot in elderly patients.

AMPUTATION WILL BE NECESSARY in the following conditions *if they result in gangrene, but not otherwise*: Compound comminuted fracture—Extensive stripping of soft parts from bone—Wound of the main artery.

THE NECESSITY FOR AMPUTATION IS INCREASED BY: Age and debility of patient—Distance from heart and bad blood-supply (hence the foot is the most likely part to require amputation)—Severe sepsis.

Punctured Wounds.—Long deep wound with small orifice.

LIABILITY TO INJURE DEEP STRUCTURES:—Blood-vessels—Nerves—Viscera—Serous cavities—Joints.

If infected, deep suppuration occurs.

OFTEN LEAVES A FOREIGN BODY in depth of wound.

TREATMENT.—

1. In the absence of evidence of sepsis or symptoms due to injury to deep structures—Simply clean and dress.

Punctured Wounds—Treatment, *continued*.

2. If deep structures give symptoms of injury—Open depths of wound, and deal with deep structures.
3. If there is any question of foreign body—Locate with X rays. Remove only if it is causing, or likely to cause, symptoms.
4. If suppuration occurs—Enlarge wound and drain.

Gunshot Wounds.—**FROM MODERN RIFLE BULLETS —**

Simple punctured wound.

Straight track between the aperture of entry—small round puncture—and aperture of exit—a small slit.

Only injures structures in its direct path.

Sepsis, or introduction of foreign bodies, is rare.

SOFT-NOSED BULLETS, dum-dum bullets, and bullets of low velocity produce much more laceration from their disruptive force.

DEEP INJURIES.—

BLOOD-VESSELS.—Fatal hæmorrhage—Traumatic aneurysm (when artery has been button-holed)—Arteriovenous aneurysm.

BONES.—Shaft: Compound comminuted fracture—Cancellous tissue may be simply perforated.

HEAD.—Splintering of the inner table—Destruction of cerebral substance along the track of the bullet—Not necessarily fatal.

ABDOMEN.—If the gut is empty its perforation closes by a local plastic process without general peritonitis.

Liver, spleen, and kidneys recover without much damage. Hæmorrhage from injury to vessels is most common cause of death.

TREATMENT OF GUNSHOT WOUNDS.—

CLEAN THROUGH-AND-THROUGH BULLET WOUNDS.—Expectant treatment.

SHELL WOUNDS.—Antitetanic serum, 500 units. Locate foreign bodies by X rays. Excise wound in cone-shaped manner, with superficial and deep tissues which have been torn and infected. Remove foreign bodies and unattached bone fragments.

Primary suture in suitable cases dealt with, within 12 hours of injury.

Delayed primary suture, i.e., inserting stitches at once and tying them within forty-eight hours if wound remains clean.

Secondary suture when cleaning only takes place by granulation.

For infected wounds, later than twenty-four hours, use one of the following methods:—

1. Salt pack. Gauze wrung out of 10 per cent salt solution.
2. Carrel's tubes and hypochlorite solution.
3. Clean with spirit and rub with bismuth iodoform paraffin paste. Pack with B.I.P.P. gauze.
4. Flavine pack.

Insect Bites.—

Bites by flies, fleas, bugs, lice, mosquitoes, etc., may result in two kinds of complications, viz. :—

1. **LOCAL INFLAMMATION WITH SEPTIC COMPLICATIONS.**
Any type of cellulitis or boil at the point stung.
Frequently marked urticaria from irritant poison of the insect bite.
Oedema may be very marked if lip, tongue, or fauces are the seat of the bite.
Septicæmia may be caused by infection of the wound by pyogenic organisms.
TREATMENT.—That of any other infected wound.
2. **THE TRANSMISSION OF SOME SPECIFIC DISEASE** of which the insect is the carrier—e.g., malaria or yellow fever from mosquitoes, plague from rat fleas, etc.

Stings of Bees, Wasps, Scorpions.—

The wound is infected with a definite irritant poison, and in the case of bee stings the sting remains in the wound. Local irritation, inflammation, and oedema will be severe.

TREATMENT.—Extraction of the sting by local incision will be necessary. Local application of alkaline lotions will neutralize the acid irritant.

Snake Bites.—

Poisonous snakes are common in India, Australia, Africa, Central and South America.

Three types of poisonous snakes are the cobra, the rattlesnake, and the viper, in this order of danger.

The venom is the secretion of the parotid gland, squeezed into grooved fangs, the teeth of the upper maxilla.

Venom is a protein substance, the chief active constituents of which are a globulin and a peptone.

It is a virulent poison to all other animals except venomous snakes. Animals, e.g., the horse, can be immunized by repeated small doses—the blood then contains an antibody. From such blood the antivenene is prepared.

The poison is destroyed by salivary and pancreatic ferments, and therefore is less dangerous when swallowed.

SYMPTOMS.—

SYMPTOMS DUE TO BLOOD CHANGES.—If injected directly into a vein, diffuse thrombosis with instantaneous death results. Otherwise destruction of blood cells and of capillary walls results, with ecchymosis, multiple hæmorrhages, oedema, and local gangrene.

SYMPTOMS DUE TO NERVE PARALYSIS.—The medullary centres become paralysed. Speech centres, swallowing, and then respiratory and heart centres fail. Death usually occurs within 24 hours.

Snake Bites, *continued*.**TREATMENT.—**

LOCAL.—Tight ligature above bitten part. Incision into bitten area, with cupping (or sucking) of the wound. Injection into the tissues of a 1 per cent solution of calcium hypochlorite or chloride of gold. Failing these remedies, rubbing in solid potassium permanganate crystals.

GENERAL.—Alcohol, ammonia, and strychnine have been advocated, but they are of the same doubtful value as in the treatment of shock.

SPECIFIC.—Injection of 20,000 units of antivenene. This is of most value for the cobra bite, and less so for that of the rattlesnake.

Methods of Healing of Wounds.—

HÆMORRHAGE fills interstices with clot.

THROMBOSIS closes ruptured vessels.

EXUDATION of leucocytes and serum from thrombosed vessels into edges of wound and blood-clot.

ABSORPTION of blood-clot and dead tissues by the leucocytes.

SUPPURATION.—If the wound is infected with a few micro-organisms of a mild type, these too are absorbed by the leucocytes. If, however, the infection is of a more virulent type, the leucocytes are killed, and form, with the serous exudation, pus.

FIBROBLASTS arise from endothelial cells and from fixed connective-tissue cells, and line the edges or surface of the wound. They are large, elongated cells, with distinct nuclei.

VASCULARIZATION of the layer of fibroblasts is brought about by a budding of solid outgrowths from the capillary walls. These outgrowths eventually become canalized, and joining other channels, form new capillary loops.

GRANULATION TISSUE is thus formed by a layer of fibroblasts vascularized by new capillary loops.

SURFACE OF WOUND heals by growth of epithelial cells from the cut epithelial edges, over the summit of the granulation tissue.

CICATRIZATION of the wound is caused by conversion of granulation tissue into white fibrous tissue, the fibrillæ of which arise from the protoplasm of the fibroblasts, or as an intercellular exudation. Both nucleated cells and blood-vessels ultimately tend to disappear from the scar tissue owing to the contraction and compression of the fibrillæ.

SCARS OF RECENT WOUNDS will therefore be more vascular, i.e., redder, than surrounding parts in their early stages, when they consist of vascular granulation tissue. They will be less vascular, i.e., paler, than surrounding parts in their later stages, when they consist of avascular fibrous tissue.

CUTICLE COVERING SCARS is devoid of any skin structure or appendages. No hair, glands, papillæ, or lymphatics.

Modifications of Healing.—

HEALING BY FIRST INTENTION.—

No gap is left between the divided wound surfaces.

No loss of tissue by sloughing or septic infection.

Granulation tissue is present as a thin layer only, between adjacent surfaces.

Scar consists of a mere line of fibrous tissue.

HEALING BY SECOND INTENTION, or healing by granulation.

A GAP IS LEFT between the divided edges of the wound, or

A GAP IS CAUSED by the loss of tissue due to sloughing or septic infection.

When the edges have been sewn up, the depth of the wound is occupied by the dead tissues, either sloughs or pus, and further healing cannot occur until these have been removed by the opening of the wound.

Small aseptic sloughs may be absorbed or digested by the subjacent granulation tissue.

Large aseptic sloughs will be simply cast off.

Septic sloughs will be separated by a process of acute inflammation involving the loss of substance of more or less of the living tissues in the edges of the wound.

THE GAPING FURROW between the wound surfaces has to be filled up by granulation tissue.

THE LARGE AREA OF GRANULATION TISSUE has to be covered over by an extensive sheet of cuticle.

The cuticle does not grow over the granulations unless the latter are on the same level as the edges of cut epithelial surface.

This 'levelling up' is produced by the gap being filled with granulation tissue, and also by the contraction of the latter drawing the edges and the base of the wound towards one another.

THE SCAR resulting from this is a large mass of fibrous tissue in which much contraction takes place.

HEALING BY UNION OF GRANULATING SURFACES.—

Produced when a gaping wound is brought together after it has become covered with granulations.

Granulating surfaces will unite if sepsis is absent, and if granulating surfaces are healthy and vascular.

HEALING UNDER A SCAB.—By granulation, when the granulating surface is covered by a mass of dried blood and exudation.

HEALING BY ORGANIZATION OF BLOOD-CLOT.—

Large spaces are left in the depth of the wound which become full of blood-clot.

Healing by Organization of Blood-clot, *continued*.

The blood is removed by leucocytes, and these are replaced by granulation tissue.

Blood only acts as a passive scaffolding for the activity of leucocytes.

Modification of Scars.—

EXCESSIVE CONTRACTION produces great deformity when large subcutaneous areas are involved in the neck or flexures of limbs.

TREAT by dividing scar, stretching contracted part, and grafting new skin.

KELOID—A vascular fibroid mass raised above the surface, and sending radiating processes in surrounding parts.

Specially frequent in tuberculous patients.

More often occurs when antiseptics are used than when these are avoided.

May be due to the involvement of a subcutaneous muscle (e.g., platysma) in the scar, constantly dragging upon it during healing.

Recur on removal, but often disappears spontaneously.

ULCERATION.—Due to defective blood-supply.

PAINFUL SCARS.—Due to implication of nerve terminals or a bulbous nerve-end by contracting scar.

TREAT by opening and freeing or excising nerve.

MALIGNANT DISEASE may attack any scar. Generally affects superficial scars subject to much irritation, e.g., X-ray burns.

Slow-growing, fungating epithelioma.

Pain and lymphatic infection do not occur until neighbouring skin is invaded.

CHAPTER X.

ASEPSIS AND ANTISEPSIS.

The systems adopted to prevent wound infection have been variously termed Antiseptic and Aseptic.

The Antiseptic System aims at the destruction of bacteria, and relies largely upon the action of chemical bactericides, wounds themselves being treated with such chemicals. Instruments are prepared by soaking in, dressings by impregnation with, skin by scrubbing with, antiseptics. The air is treated by an antiseptic spray, and the wounds are constantly bathed in antiseptic solutions.

The Aseptic System aims at the prevention of wound infection by excluding bacteria from the wound, relying almost entirely on heat for the destruction of germs, and using no chemicals in contact with wounded tissues. Instruments are boiled, dressings are steamed, skin surfaces are excluded from wound contact.

The Two Systems Compared.—It is obvious that neither the antiseptic nor the aseptic ideal can ever be fully realized.

OBJECTIONS TO THE ANTISEPTIC SYSTEM:—

1. Chemical solutions which kill bacteria cannot act efficiently if the latter are embedded in fatty and albuminous material or buried in the tissues.
2. Antiseptic solutions powerful enough to kill bacteria injure the living tissues of the wound.

OBJECTIONS TO THE ASEPTIC SYSTEM:—

1. Heat as a germicide cannot be applied to skin surfaces or to the atmosphere; hence the germs from these two sources of infection cannot be destroyed.
2. Skin surfaces cannot be shut off from wound contact. The same, of course, applies to the atmosphere.

THE OBJECTIONS TO BOTH 'SYSTEMS'.—There is an obvious danger of either 'system' degenerating into a formal ritual; and it is far better, therefore, to be acquainted with the various means at our disposal for combating the risks of infection, and to be prepared to use them as circumstances may demand. Practically no one to-day practises the full 'aseptic' or 'antiseptic system'. The air cannot be sterilized by chemical sprays, neither can bacteria be rooted out of the skin by scrubbing. But there is still a tendency with some to place an unreasoning faith in chemical solutions, and an equally irrational confidence on the part of others in soap and water.

The Modern System.—All are agreed that there are three great factors in the prevention of wound infection, viz. :—

VITAL RESISTANCE of the living tissues.

EXCLUSION OF BACTERIA from contact with wounds.

DESTRUCTION OF BACTERIA by artificial agencies.

These three factors differ in their relative importance under different circumstances, thus :—

IN DEALING WITH HEALTHY TISSUES AND UNDER IDEAL CIRCUMSTANCES.—It is possible so far to exclude germs that the vitality of the tissues can be depended upon to prevent infection without the use of any chemicals.

IF THE TISSUES ARE ALREADY INFECTED.—E.g., in dealing with an abscess. The exclusion of further infection is all that can be attempted, and it is useless to apply chemicals to the tissues to kill the germs *in situ*, because the vital resistance will be injured as much as the vitality of the bacteria.

WHEN INFECTION IS PROBABLE OR CONDITIONS ARE NOT IDEAL.—E.g., an amputation in the proximity of unhealthy tissues, or emergency operations in poor houses with inexperienced assistants. The use of antiseptic solutions throughout the operation, both in bathing the wound and in saturating the towels which surround it, will be a great safeguard in preventing infection. The chemicals used are dilute, and serve rather to inhibit the action of bacteria than to kill them outright.

THE PREPARATION OF SKIN SURFACES is the most difficult and debatable factor in the whole subject. It is agreed that it is impossible always to render the skin aseptic or entirely to exclude its contact with the wound. Hence after all has been done to render it sterile, it is treated as an infective agent and excluded as far as possible.

THE PREPARATION OF DRESSINGS, LIGATURES, AND INSTRUMENTS.—Here all agree that sterilization by heat is the best method of routine, but the use of chemical antiseptics finds a place under certain circumstances (*see below*).

THE USE OF SPECIAL ANTISEPTICS.—Certain chemical substances are still largely used under special circumstances, and an exact knowledge of their mode of action is desirable, lest their employment should degenerate into a fetish.

The Factor of the Vital Resistance of the Living Tissues.

AGE AND IDIOSYNCRASY.—Old people are much more liable to infection than young. This results generally from defects in the circulation. Certain individuals are much more liable to infection than others.

CIRCULATION.—Good general and local circulation is probably one of the most important factors in resistance to infection.

Vascular parts, e.g., the head and neck, usually heal well in spite of infection.

Avascular parts, e.g., tendons, long skin flaps, are very liable to infection.

Morbid blocking of the vessels, e.g., in the feet of old people, makes ready healing without infection almost impossible.

Hyperæmia artificially produced promotes healing and enables the infected tissues to combat infection much more rapidly (*see* PASSIVE HYPERÆMIA).

Parts deprived of circulation are the most difficult to keep aseptic, hence the common sequence of suppuration upon gangrene.

EXCRETION.—

A healthy action of kidneys, skin, and lungs is most important. In conditions of NEPHRITIS and renal insufficiency infection is common.

THE PROMOTION OF RAPID EXCRETION by copious infusion of saline solutions is one of the most potent agents in combating infection.

MORBID CONDITIONS OF THE BLOOD.—

DIABETES is the most notable condition in which the resistance to microbic invasion is much lowered.

NEPHRITIS, DEBILITY, AND MARASMUS act in the same way, though in a less degree.

LOCAL CONDITIONS AFFECTING TISSUE VITALITY.—Any contusion of the wound predisposes to infection; hence the following often lead to suppuration:—

THE USE OF BLUNT INSTRUMENTS, lacerated and contused wounds.

Any lesion which causes BLOOD EXTRAVASATION, e.g., a hæmatoma.

PROLONGED HANDLING, dragging, cooling, or applying strong chemicals to the tissues.

Hence a NEAT AND QUICK OPERATOR who uses sharp knives and needles will get better healing than one who is slow and clumsy and uses blunt instruments.

Also multiple stitches which bring together tissues in layers without tension are less likely to suppurate than HEAVY SUTURES which grasp large masses of tissue with MUCH TENSION.

CONSTITUTIONAL IMMUNITY AND RESISTANCE TO INFECTION.—Apart from natural and individual immunity, over which we have no control, there are the following methods available by which the tissue resistance to infection can be increased:—

PROPHYLACTIC INJECTION OF ANTIBACTERIAL AND ANTITOXIC SERA, e.g., before an extensive operation for an ulcerating cancer of the mouth.

CURATIVE INJECTION OF SIMILAR SERA after infection. The polyvalent antistreptococcus serum is of most use in this way.

Methods of Increasing Resistance to Infection, *continued*.

VACCINE TREATMENT.—The injection of measured quantities of dead organisms grown from the source of infection greatly increases the power of resistance.

INJECTION OF MATERIAL CAUSING LEUCOCYTOSIS.—Nucleic acid and sodium cinnamate have been proposed, the former particularly when peritoneal infection is feared.

EFFECT OF CHEMICALS ON THE TISSUE VITALITY.—

STRONG ANTISEPTICS, e.g., 1-20 carbolic or 1-1000 perchloride, injure the living tissues, kill the leucocytes, and thus lower the natural vital resistance.

WEAK ANTISEPTIC SOLUTIONS, e.g., 1-40 carbolic or 1-4000 mercury biniodide, injure the tissues very little if at all, whilst they decidedly inhibit the action of germs introduced from the air or skin.

THE CHARACTER OF THE TISSUES is of importance in this connection. Serous surfaces have a great power of natural resistance to infection, but are readily injured by even dilute chemicals. Synovial surfaces, bone, and muscle tissue have less microbe-resisting power, but are tolerant of weak antiseptics.

The Exclusion of Bacteria from Wounds.—

BACTERIA IN THE SKIN.—These lie deep in the epidermis and in hair follicles and sweat glands, and cannot be destroyed with any degree of certainty. Hence, whatever skin preparation has been used, skin is always to be regarded as potentially infective and excluded from wound contact.

THE HANDS OF THE OPERATOR and assistants are covered with sterilized rubber gloves and the arms by sterilized long sleeve gowns.

THE SKIN OF THE PATIENT is clipped by its cut edges to sterilized towels as the first step of every operation.

BACTERIA IN THE AIR.—Ordinary air contains only few bacteria. In still air the bacteria sink to the ground and are fixed by contact with any moist surface.

AIR IN OPERATING-THEATRE.—Is in some cases filtered through cotton-wool. In all cases dust is prevented from accumulating by providing non-absorptive surfaces with no crevices or sharp angles. All draughts have to be avoided, so that floating bacteria be not blown into the wound.

AIR IN EMERGENCY OPERATING-ROOMS.—If there is ample time for preparation, a thorough cleansing and removal of all dust-carrying furniture and ornaments are desirable. But when there is less than twelve hours between the room preparation and operation, the less the dust is disturbed the better. The dust is much more dangerous in the air than on the carpet.

AIR EXPIRED BY THE OPERATOR AND ASSISTANTS.—Whilst quietly expired air has few microbes, that which accompanies speech is laden with the bacteria from the mouth. The

operator and all who have to speak, leaning over the wound, must wear a MASK or respirator. A CAP prevents scurf falling from the hair into the wound, but a mask serves the double purpose of excluding the bacteria from the head and the mouth.

GASTRO-INTESTINAL BACTERIA.—It is probably impossible to render the mouth or intestine sterile, but in healthy conditions the stomach and upper part of small gut are almost free from bacteria. Further, the number and virulence of germs in the mouth and large intestine can be greatly reduced by the following means:—

MOUTH.—Removal of carious teeth, sordes, and tartar. Mouth-washes of astringents and antiseptics (e.g., alum gr. x ad $\bar{3}$ j; protargol gr. j, glycerin $\bar{3}$ j, aq. $\bar{3}$ j).

STOMACH.—Gastric lavage in diseases of or operation on the stomach. Feeding before and after the operation by sterilized food.

INTESTINE.—Free purgation before every operation. Where this is not possible, e.g., in intestinal obstruction, it is better to evacuate the intestinal contents by an artificial anus before performing a more extensive operation.

The Destruction of Bacteria.—

OUTSIDE THE BODY.—Here heat is almost universally employed, but antiseptics still have a useful place.

DRY HEAT has to reach 130° and be maintained for a very long time before the spores of bacteria are killed. It is therefore seldom used.

STEAM HEAT is used at a temperature of 100° to 120° C. for all dressings, coats, towels, etc. (*see* p. 93).

CHEMICALS are useful for materials which cannot be boiled, e.g., woven catheters; also for rapid sterilization, e.g., a towel required in an emergency operation wrung out of 1–20 carbolic, or a scalpel dipped in pure carbolic.

IN THE TISSUES.—When bacteria are actually in the living tissues nothing but the living tissues can destroy them.

ON THE SKIN.—When bacteria are on the surface of the skin a great deal can be done to destroy them, viz. :—

REMOVAL BY MECHANICAL MEANS, e.g., scrubbing with soap and water.

FIXATION by such agents as alcohol, iodine solution, and rubber solution.

DESTRUCTION BY ANTISEPTICS.—This involves a long and laborious process which is seldom entirely successful.

Preparation of the Patient's Skin.—

THE IODINE METHOD.—The parts are washed with soap and water and shaved if necessary. This should be at least twelve hours previous to the iodine application, as the skin absorbs iodine much better when dry than macerated. The iodine is used as a 5 to 10 per cent solution in 80 per cent alcohol. Most

Preparation of the Patient's Skin, *continued*.

commonly it is applied at the time of the operation. Some prefer to make two applications, one the day before and one at the time of the operation.

PICRIC ACID METHOD.—Picric acid as a 5 per cent solution in methylated spirit or a 3 per cent solution in water is now used in preference to iodine, because it has a longer endurance in the skin, and is free from the danger of forming a compound irritating to the eyes, such as arises from iodine and some kinds of spirit.

Preparation of the Surgeon's Skin.—

THE SURFACES ROUND THE FINGER NAILS are exceptionally difficult to sterilize. Nails are to be kept short.

THE CONSTANT USE OF ANTISEPTICS will make the skin so cracked as to be impossible to clean.

FULL MECHANICAL CLEANING is impossible, as shaving and the removal of surface epithelium are its most important factor.

THE HANDS OF THE SURGEON are liable to virulent septic contamination by contact with the mouth, rectum, or inflammatory products. Hence, whilst more difficult to sterilize, it is much more important for them to be sterile than the patient's skin.

RELATION TO TIME.—Even if sterilization of the skin were possible, the time occupied makes such impracticable. For example; the passage of a catheter, which may take one minute, would have to be preceded by hand preparation taking fifteen!

USE OF GLOVES.—Hence rubber gloves are to be used as follows: (1) For every aseptic operation, to prevent infection by the surgeon's hands; (2) For every septic operation or manipulation, to prevent the surgeon's hands becoming infected by fresh and virulent organisms; (3) The hands are always cleansed mechanically and by spirit, or spirit and biniodide, before putting on the gloves, lest a puncture should occur.

USE OF SLEEVES.—The arms are covered by sterilized sleeves which overlap the gloves.

Sterilization of Instruments.—

BOILING is the routine method.

TIME.—Twenty minutes is ample, even when the instruments have been infected. Five minutes is enough to kill all ordinary pyogenic organisms.

SOLUTION.—Bicarbonate of soda $\frac{3}{4}$ j to the pint is used. This prevents rusting, and the boiling-point is higher than plain water. The solution should be boiling at the time the instruments are placed in it.

PREPARATION.—All blood, etc., should be removed by scrubbing from the interstices before boiling, lest the germs should be protected by the coagulated albumin.

SHARP INSTRUMENTS, especially scalpels, amputation knives, and razors, should be sterilized by ten minutes' immersion in 80 per cent spirit. For rapid sterilization of any instrument in emergency, one minute in pure carbolic is much more efficient than hasty boiling.

CATHETERS and other instruments made of woven material must be sterilized by immersion in 1-500 solution of biniodide of mercury, or by exposure to formalin vapour.

Sterilization of Ligatures.—

NON-ABSORBABLE LIGATURES, viz., wire, silkworm gut, silk, and thread, are boiled. But the last three are spoiled by repeated boiling.

CATGUT AND TENDON LIGATURES are largely used because they are absorbed in the tissues. The former is made from the submucous tissue of sheep's intestines and needs careful preparation, especially in view of the fact that it may convey tetanus infection. Boiling in water destroys it.

CHEMICAL METHODS.—Saturation in sulphurous and then in chromic acid is Lister's method, which has never been proved faulty. Soaking in iodine solution is a more modern method.

THERMAL METHODS.—Boiling in xylol or other oils.

STORAGE.—Usually in alcohol or xylol, which preserves its hardness; or in 1-1000 watery biniodide, which renders it soft and elastic but difficult to tie firmly.

Sterilization of Dressings, Towels, Gowns, Gloves, and Swabs.—

BOILING is efficient, but not convenient, because the materials must then be used wet and cannot be transported.

ANTISEPTICS.—Soaking in 1-20 carbolic is efficient, and FOR TOWELS to be used for septic operations and in conditions where competent trained nurses are not available, is the safest method.

LOW-PRESSURE STEAM.—Fabrics are placed in an autoclave over boiling water. This raises the temperature to only 100° C., and the interior of large masses of non-conducting materials will not be raised to this unless the temperature is maintained for many hours. They are apt to be wet when taken out.

HIGH-PRESSURE STEAM.—This is the method almost universally employed.

ADVANTAGES.—By exposure to steam under high pressure a temperature of 110° to 120° C. is reached, which is enough to kill the spores of anthrax or tetanus. By exhausting the air from the sterilizing chamber before admitting the steam, the latter penetrates the interior of the largest masses of fabric. By similarly exhausting the chamber after sterilizing the fabrics are dried.

DISADVANTAGES.—A costly and complicated apparatus is

Sterilization of Dressings, etc., *continued.*

required. Skilled, experienced, and trustworthy manipulators are essential for proper working. About two hours are occupied in the process. A colour index tube ought to be used with each packet of material. This changes colour at a given temperature, and shows that this temperature has been attained.

THE USE OF DRY DRESSINGS, quite apart from the method of sterilization, is a most important advantage. A wound will resist infection when dry which would suppurate if it were kept moist, because bacteria cannot grow in a dry environment.

Sponges.—MARINE SPONGES are more absorptive than any other. They can be efficiently sterilized by a long and complicated series of chemical processes. But few care to risk such a process being inefficiently carried out. Hence these are now practically abandoned. Sponges made of gauze are prepared like the dressings.

The Use of Special Antiseptics.—There are many chemicals, solutions, and powders recommended for special purposes. Only those of general use need be mentioned.

IODOFORM is only an active antiseptic when it liberates nascent iodine in the tissues. The powder ought to be boiled, as in its dry state it may be contaminated by germs which it has no power of killing. Its chief use is in tuberculous abscesses and bone cavities.

FORMALIN or formaldehyde is used chiefly in sterilizing rooms or catheters, when it is employed as a vapour.

PEROXIDE OF HYDROGEN in solution is used for irrigation of suppurating and stinking cavities, e.g., an appendix abscess. The rapid liberation of nascent oxygen is its active principle, which mechanically cleans and stimulates the tissues and acts as a deodorant.

PROTARGOL (AND OTHER SILVER SOLUTIONS).—Generally employed in a strength of 1 to 4 gr. to the ounce. Is used for mucous surfaces—nose, mouth, urethra, or bladder. It acts both as an antiseptic and an astringent.

SODIUM OR POTASSIUM PERMANGANATE (Condy's fluid, 1-5000) is used for copious irrigation of mucous surfaces, e.g., the mouth and vagina.

HYPOCHLORITE OF SODA, as eusol (solution), eupad (powder), Dakin's solution, chloramine, and dichloramine-T, was used extensively in the War for the treatment of infected wounds.

THE CARREL-DAKIN METHOD.—The wound is excised carefully, and all grossly infected tissues and foreign bodies are removed. Small rubber tubes with lateral perforations are placed in all deep recesses. These are connected by glass and rubber

tubes to a receptacle containing Dakin's solution. *Dakin's solution* is a fresh solution of hypochlorite, which must be of neutral reaction and contain 0.45 per cent of the drug. The solution is instilled into the wound at intervals of two to four hours. Outside dressings and tubes are changed daily, with aseptic precautions. The skin round the wound is smeared with sterile vaseline to prevent blistering. Twice weekly bacterial counts of the wound are made, and when infection has disappeared secondary suture is performed.

B.I.P.P., i.e., bismuth-iodoform-paraffin paste, in proportions of 1, 2, and 3, is used for infected wounds. The grossly infected tissues are excised. The parts are dried and rubbed with spirit. B.I.P.P. is then rubbed into all the wound recesses. B.I.P.P. gauze is packed in. The deep dressing need only be changed every two or three days.

CERTAIN ANILINE DYES are also used for infected wounds. The chief are brilliant-green and flavine.

FLAVINE (1-1000 solution) is used after mechanical cleansing and excision.

MERCUROCHROME, 1.0 per cent or 0.5 per cent, is of particular use as a genito-urinary antiseptic.

CHAPTER XI.

SHOCK, SYNCOPE, AND COLLAPSE.**Definitions.—**

SHOCK is the state of exhausted vitality resulting from and occurring immediately after injury.

SYNCOPE is a state of reflex inhibition of the cardiac and respiratory centres.

COLLAPSE is a term used in different senses: (1) As synonymous with syncope; and (2) As a term for the state resembling shock which comes on as the result of slow toxic injury, e.g., in peritonitis and intestinal obstruction.

SHOCK.**Varieties.—**

PRIMARY SHOCK.—The immediate result of a severe trauma, especially of a blow on the head or abdomen. Blood-pressure falls at once, which is probably due to a reflex cardio-inhibitory effect.

SECONDARY SHOCK.—Develops slowly after a prolonged operation, and is usually the result of a combination of trauma, hæmorrhage, exposure, and toxæmia from the toxins of injured tissues.

Pathology.—

FALL OF BLOOD-PRESSURE is the cardinal fact, and its degree may be regarded as the measure of shock. The systolic pressure, which is normally 110 to 120 mm., falls to 50 or 40 mm.

ARTERIES are greatly contracted.

CAPILLARY STASIS.—The capillaries are dilated, and the viscosity of the blood and the corpuscle content are increased in the capillary area.

VOLUME OF CIRCULATING FLUID is decreased owing to transudation as a result of increased permeability of capillary walls.

VENOUS RETURN to heart is deficient.

DIASTOLIC FILLING is incomplete.

CORONARY CIRCULATION is inefficient.

TOXINS FROM CRUSHED TISSUES.—When a limb has been extensively crushed or lacerated, there arises a toxic material (histamine) which rapidly produces shock. Such shock is prevented by the use of a tourniquet and the excision of the crushed muscle, or amputation, before the circulation is restored.

ACAPNIA, i.e., reduction of the normal CO_2 content of the blood. Excessive nerve stimuli cause excessive breathing; this reduces the CO_2 . Further, exposure of the intestines to the

air causes rapid loss of CO_2 . In the absence of CO_2 from the blood, the respiratory and possibly other vital nerve centres lose their normal stimulus; hence the activity of the respiratory, cardiac, and vasomotor centres is depressed.

Predisposing Causes.—

AGE.—

INFANTS UNDER ONE WEEK display shock slightly, because the peripheral nervous mechanism is not fully functional.

CHILDREN suffer severe shock.

OLD AGE.—In old people the blood-pressure is higher than normal. There is a relatively small fall in the blood-pressure, but nevertheless the patient has feeble rallying power.

SEX.—Women are slightly less susceptible than men.

NATIONALITY.—The highest races show most shock; Orientals and negroes comparatively less.

TEMPERAMENT.—Nervous and highly cultured people suffer more than phlegmatic and dull ones.

TIME OF DAY.—Shock is most pronounced between midnight and dawn, especially with a sleepless night, i.e., a state of exhaustion. Least marked in the morning after a good night's sleep.

DEBILITY.—Cachectic states, especially that due to malignancy; anæmia following hæmorrhage; toxic conditions, especially those due to septic absorption; all conduce to severe shock.

Exciting Causes.—

IN GENERAL TERMS, any peripheral or cerebral stimulus sufficient to exhaust the medullary nerve centres.

DEGREE OF SHOCK IS IN PROPORTION TO :—

NUMBER OF STIMULI, i.e., of nerves stimulated or injured.—

Hence injury of parts richly supplied with nerves, e.g., the skin, testis, or hand, causes much shock.

DURATION OF STIMULI.—Hence the length of an operation is an important factor.

INTENSITY OF STIMULI.—Rough injury, tearing, crushing tissues causes more shock than clean-cut wounds. Skilful manipulation and use of sharp instruments give less intense stimulation to the tissues, and hence less shock.

PROXIMITY OF SEAT OF STIMULATION TO NERVE CENTRES.—

Shock is great in injuries of and operations on: The brain, spinal cord—Large cranial nerves, especially the optic and auditory—Large nerve plexuses, both sympathetic and spinal.

PRESENCE OF CONTRIBUTORY FACTORS which LOWER BLOOD-PRESSURE.—Of these hæmorrhage is the chief. Lowering of the body temperature and exposure of viscera act in a less direct manner. Conversely, the prevention of hæmorrhage, of cold, or exposure, and employment of means which directly maintain the blood-pressure, lessen shock.

Shock—Exciting Causes, continued.

PSYCHICAL CAUSES.—These acting alone usually produce syncope rather than shock. But when associated with injury they increase shock. Intense fear of an operation or horror in an accident may be the greatest factor in shock production.

TOXIC AND CHEMICAL.—Usually these act slowly and cause gradual collapse. When they act suddenly they result in shock, e.g., the swallowing of corrosive poisons or the bursting of an abscess into the peritoneal cavity.

THERMAL.—Burns often cause death from shock alone, and then one or more of the following factors are present :—

1. **AN EXTENSIVE AREA** of skin is affected—about one-third of the total skin area.
2. **AGE.**—The patient is a child or a feeble old person.
3. **DEGREE.**—The burn is one of the 1st or 2nd degree, in which the nerve termini are irritated but not destroyed.

MECHANICAL.—

TRAUMATIC INJURIES, especially contused and lacerated wounds. Clean-cut wounds and wounds by modern rifle bullets cause comparatively little shock in the absence of injury of important viscera.

ALL SURGICAL OPERATIONS.

Symptoms and Signs.—

BLOOD-PRESSURE.—Thus, as the cardinal factor, is regarded as the most direct measure of shock.

NORMALLY the blood-pressure is 120 to 140 mm. of mercury.

PATHOLOGICALLY it is raised up to 200 mm. by old age, arteriosclerosis, granular kidneys, cerebral compression. It is lower in various toxic conditions, anæmia, and marasmus.

DEGREE OF LOWERING.—It is commonly lowered below 100 mm. by severe operations. Anything below 80 mm. signifies danger; 20 mm. in the carotids represents the lowest point compatible with life.

CIRCULATION.—The arteries are contracted, and an undue proportion of the blood collects in the venous channels.

PULSE is short and quick and easily compressed, rising in severe shock to 140, above which it is difficult to count owing to the low blood-pressure.

RESPIRATION.—The breathing is quick, sighing, and irregular. Inspiration and expiration are shortened, and the pause between is lengthened.

FACE is blanched and shrunken, the nose pinched and dusky.

The eyes are lustreless and rolled up beneath the lids.

The eyeballs are deeply sunk in their sockets.

The jaw droops, the parted lips are pale.

SKIN is pale, cold, and clammy. Sweating is a marked feature and difficult of explanation. It may be due to the relaxed state of the skin or to toxic products circulating in the blood.

SECRETION from other glands is diminished.

TEMPERATURE falls to 97° or 96° F. owing to the dilated condition of the cutaneous vessels and to the profuse sweating.

NERVOUS SYSTEM.—

CEREBRAL PROCESSES are diminished and the intellect wanders.

MUSCLES, both striped and unstriped, are relaxed and toneless.

REFLEXES are diminished.

REACTION AFTER SHOCK.—Certain phenomena accompany the recovery from shock.

BLOOD-PRESSURE rises slowly.

PULSE AND RESPIRATION become slower and more regular.

VOMITING occurs with the return of consciousness.

CONSCIOUSNESS returns after the reflexes have been restored.

THE TEMPERATURE rises to about 99°.

Prevention of Shock.—

GENERAL MEASURES.—

REST, especially to the nervous system. A few days in bed before an operation, a good night's sleep, procured by an opiate if necessary, avoidance of alarming knowledge of the preparation for the operation.

DRUGS.—Until recently stimulants, e.g., brandy or STRYCHNINE, were commonly given before an operation to prevent shock. According to the modern conception, however, a sedative is of more value. And therefore MORPHIA (gr. $\frac{1}{4}$ to $\frac{1}{2}$) is given, and acts most powerfully by diminishing the sensibility of the nerve centres.

MAINTENANCE OF TEMPERATURE by warm clothing of the body and limbs, covering exposed viscera by hot compresses, and using a heated operating-table and a warm operation-room.

MAINTENANCE OF BLOOD-PRESSURE, especially in the head region. The head low, or Trendelenburg position. Firm bandaging of the limbs. Encasing the patient in an inflatable rubber suit.

AVOIDANCE OF HÆMORRHAGE.

THE ANÆSTHETIC.—The relation of shock to anæsthesia is a very complex one.

FULL GENERAL ANÆSTHESIA diminishes the capacity of the nerve centres for the receipt of stimuli. But such a degree of anæsthesia must in itself tend to lower the nerve vitality. Hence the general rule is to have full anæsthesia during skin incisions and certain visceral manipulations, e.g., in dilating the sphincter ani, dragging on adhesions, etc., and light anæsthesia for the rest of the operation.

SPINAL ANÆSTHESIA, where available, is the most potent preventive of shock. It blocks the paths of afferent impulses during the operation, whilst avoiding the toxic effects of a general anæsthetic on the nerve centres.

Shock—Prevention, *continued*.

After the operation, when the action of the stovaine wears off, a modified degree of shock appears.

NITROUS-OXIDE-OXYGEN anæsthesia has been proved by Crile to have many fewer shock-producing properties than ether or chloroform. As judged by the condition of the cerebral nerve cells, it injures one-fourth as many as does ether in similar circumstances.

BLOCKING THE NERVE TRUNKS.—In severe operations where the main nerves can be exposed and where spinal anæsthesia is not available, the injection of eucaïne (gr. 2) or novocain (gr. 5) into the nerve trunks is of great value. The chief examples of its use are in the forequarter amputation and in laryngeal operations; in the latter the superior laryngeal nerves are treated.

Treatment.—

PREVENTIVE.—The above detailed measures should be carried out where applicable in order to prevent the further development of shock.

STIMULANTS—The value of all stimulants, e.g., alcohol, ether, digitalis, strychnine, is a matter on which great difference of opinion exists. All these remedies, especially alcohol (brandy $\frac{3}{4}$ j in pint of hot saline per rectum) and strychnine ($\frac{1}{10}$ ij to v hypodermically), are still used, and common opinion supports their value. But when tested by the blood-pressure it is found that a short rise is followed by a lasting depression. They, accordingly, have been likened to 'whipping a dying horse'. They probably are of value in the less degrees of shock, and of doubtful utility in its more intense forms.

THE USE OF OXYGEN.—When this is given it ought to be mixed with 10 per cent CO₂ in order to provide the necessary respiratory and vasomotor stimulus.

BLOOD-PRESSURE RAISERS.—The most accurate and powerful agent is the pneumatic suit mentioned above.

ADRENALIN ($\frac{1}{10}$ x to xv of 1-1000 solution) given with a saline infusion raises the blood-pressure by direct action on the vessels. **ERGOTININE** acts in the same way less powerfully. But in both cases the action is very transient, lasting only for a few minutes.

PITUITARY GLAND EXTRACT is said to have a more lasting effect.

MECHANICAL AND THERMAL.—Low head position, bandaging the extremities, blankets and hot-water bottles (*see* p. 99).

SALINE INFUSIONS.—Normal salt solution at a temperature of 102° F.

VENOUS.—Direct into a large vein, giving slowly one or two pints at a time.

PERITONEAL.—Several pints introduced into the peritoneal cavity before closing the abdomen after laparotomy.

RECTAL.—Given by continuous infusion at a low pressure at

the rate of about one pint an hour. Of especial value in conditions of peritoneal sepsis.

SUBCUTANEOUS.—Given into the thighs or *mammæ* continuously. There is a danger of the skin sloughing.

Saline infusions are of most value when shock has been aggravated by hæmorrhage. For conditions of simple shock, or for shock combined with anæmia, the intravenous infusion of saline or saline with 1-20,000 adrenalin is the best. For shock associated with toxic or septic conditions, continuous infusion subcutaneously or per rectum is the best. These latter methods only act efficiently when there is sufficient blood-pressure and circulation to permit of rapid excretion.

DIRECT BLOOD TRANSFUSION.—This is perhaps the most potent means of restoring the vitality. (*See* p. 125)

SYNCOPE.

Syncope is the reflex inhibition of the cardiac and respiratory centres by psychical, cerebral, or traumatic causes.

Causes.—

PSYCHICAL.—Emotion, especially fear or grief.

CEREBRAL.—Anæmia of the brain. Particularly when abruptly produced in anæmic persons, e.g., by suddenly rising from recumbent position.

TRAUMA.—Sudden blows in the epigastric region. Dragging upon viscera during operations. Dilatation of the sphincter ani. Operations in the region of the superior laryngeal nerve.

ATMOSPHERIC CONDITIONS, e.g., crowded hot rooms.

Relation to Anæsthesia.—Syncope during anæsthesia is usually due to the ANÆSTHESIA NOT BEING COMPLETE, allowing the nerve centres to be inhibited by the stimulus of the operation, e.g., by dilatation of the sphincter ani. Also to cerebral anæmia in HEAD-UP POSITIONS—hence the danger of operations under anæsthesia in the sitting posture. If these must be undertaken, the patient should either be in a pneumatic suit, which allows of rapid driving of the blood to the brain, or else the position should be capable of alteration at a moment's notice.

Pathology.—Whilst syncope consists, just like shock, in a low blood-pressure with cardiac and respiratory inhibition, it differs essentially from it in its relation to the nerve centres. In syncope there is mere inhibition or anæmia, whereas in shock there is exhaustion. Hence syncope is easily and readily treated.

Symptoms and Signs.—Are practically identical with those of shock, but they are much more sudden in their onset, and hence during operations must be treated with greater promptitude. A tendency to VOMITING often occurs.

Treatment.—Head-down position. Rhythmic pressure of the heart. Artificial respiration. Stimulants—alcohol, ether, or strychnine.

CHAPTER XII.

ANÆSTHESIA.***I. GENERAL ANÆSTHESIA.****Mortality of General Anæsthesia.—**

Nitrous oxide	1 in 100,000	A.C.E. and C.E.	1 in 7000
Ethyl chloride	1 in 12,000	Chloroform	1 in 1000
Ether	1 in 10,000		

(These figures are according to Luke. Other authors give a lower mortality, but with the same comparative rates.)

Choice of an Anæsthetic.—**PATIENT'S CONDITION.—**

CONDITIONS SPECIALLY UNFAVOURABLE FOR CHLOROFORM.—
 Anæmia — Marasmus — Cachexia — Adenoids — Diabetes —
 Septic infections — Insanity — Myasthenia cardis — Angina
 pectoris — Fatty heart.

CONDITIONS SPECIALLY UNFAVOURABLE FOR ETHER.—Laryngeal
 spasm or obstruction—Disease of lungs and pleura—Bron-
 chitis — Emphysema — Asthma — Atheroma — Aortic aneu-
 rysm—Renal disease—Insanity—Cautery operations near the
 mouth.

CONDITION SPECIALLY FAVOURABLE TO CHLOROFORM.—Preg-
 nancy (except eclampsia).

PATIENT'S AGE.—

CHILDREN UNDER 5 —Chloroform is well tolerated, but C.E.
 mixture is the best.

AGE 5-15.—C.E. mixture is best, as ether alone causes so much
 mucous secretion.

AGE 15 UPWARDS.—Ether is the routine anæsthetic.

NATURE OF THE OPERATION.—**GAS OR ETHYL CHLORIDE.—**

Dental extraction — Superficial abscesses — Tenotomy —
 Aural polypi—Forced movements of joints—Cautery—
 Adenoids—Removal of tamponade.

CHLOROFORM.—

Face, tongue, and jaw operations—for mechanical reasons.
 Neck and head—because of venous congestion which
 accompanies ether.

Chest operations—breathing is quieter.

Some abdominal operations—when sufficient relaxation is
 not obtainable with ether, or when respiratory move-
 ments are too vigorous.

During labour.

ETHER for all other operations.

* Luke's and Hewitt's text-books on Anæsthesia.

Administration of Gas.—

PHYSICAL PROPERTIES.—Nitrous oxide or laughing gas (N_2O). Stored in a liquid form in metal cylinders.

APPARATUS.—A 3-gallon rubber bag is filled from the gas cylinder and attached to a face-piece. Valves are arranged so that air, gas, or a mixture can be given.

TECHNIQUE.—Patient is usually seated. Gag is inserted before application of face-piece. Few breaths of air are given. Pure gas is then breathed in and out of the bag. The face-piece must fit accurately to exclude air.

SIGNS.—Breathing deep and stertorous. Pulse full and bounding. Clonic contractions, with jactitation of limbs. Pupils dilate. Corneal reflex is lost.

Time taken for induction, one minute.

Duration, half to three-quarters of a minute.

MODIFICATIONS.—

PROLONGED GAS ADMINISTRATION may be induced for long operations, even those lasting for hours, by giving oxygen mixed with the gas in the proportion of 10 to 5 N_2O . From the point of view of ideal anaesthesia, absence of shock, and post-anaesthetic vomiting, this seems to be the best method.

The advantages are: The minimum of toxicity; the pleasantness of induction; the rapid recovery; the absence of shock or severe after-effects.

The disadvantages are: It is difficult to administer; there is often rigidity and struggling; it requires elaborate apparatus; it is very expensive.

PHYSIOLOGY.—Nitrous oxide combines loosely with hæmoglobin. Exerts a specific action on nervous system. The effect on the circulation is stimulating.

AFTER-EFFECTS.—Practically nil. Headache, nausea, and vertigo occasionally.

Administration of Ethyl Chloride.—

PHYSICAL PROPERTIES.—Ethyl chloride ($\text{C}_2\text{H}_5\text{Cl}$). Very volatile colourless liquid. Highly inflammable. Stored in glass phials holding 50 to 60 c.c.

APPARATUS.—A rubber bag and face-piece with aperture for admission of the drug.

TECHNIQUE.—Patient may be seated or supine. 5 c.c. (or 3 c.c. with children) are introduced into the bag, where it volatilizes. Whilst a face-piece and bag are on the patient's face, the ethyl chloride is introduced gradually at the other end of the bag until about 2 c.c. have been used.

SIGNS.—Deep stertorous breathing. Dilated pupils, loss of corneal reflex. Relaxation of spasm of muscles. The masseter muscle is specially prone to spasm. Full pulse, with flushed face.

Administration of Ethyl Chloride, *continued*.

Time taken in induction, about 1 minute.

Duration of anæsthesia, $1\frac{1}{2}$ minutes.

AFTER-EFFECTS.—Headache and sickness in about a quarter of the cases.

Administration of Ether.—

PHYSICAL PROPERTIES.—Ether, $(C_2H_5)_2O$, is prepared from alcohol. Colourless volatile liquid. Specific gravity 0.72. Leaves no residue on evaporation. No reaction with litmus. Pure ether is prepared from rectified spirit. Pure methylated ether from methylated spirit. Both are equally good for anæsthetic purposes (Hewitt).

OPEN ETHER.—Induce anæsthesia by chloroform, a mixture of chloroform and ether, or by a Clover's inhaler. In order to secure the best type of anæsthesia, administer three-quarters of an hour before operation a subcutaneous injection of atropine. When anæsthesia has been established, place on the patient's face a gauze pad, or a pad of Gamgee tissue, with an opening for the nose and mouth, and over this place the mask covered with gauze or domette. Ether is now added to the mask to maintain the anæsthesia which has already been induced. Special care should be taken to maintain a free air-way.

ADVANTAGES.—Absence of cyanosis. Applicable to every type of case in which ether can be used. Safety.

DISADVANTAGES.—Low temperature of inhaled vapour. In some patients difficulty may be experienced in maintaining anæsthesia at the required depth. It is rather extravagant in the quantity of ether used.

WARMED ETHER.—Air is pumped by means of a hand bellows, foot blower, or electric pump, through ether or chloroform; the resulting vapour is passed through a worm immersed in hot water and conducted to the face-piece. If it is wished to give a mixture of chloroform and ether, the two drugs must be in separate bottles, and the vapour mixed before reaching the face-piece; the two drugs must not be mixed together in one bottle, owing to the different rates at which they evaporate. The tube from the warming apparatus to the face-piece must be less than three feet long.

ADVANTAGES.—Prevents the reduction of the body temperature to an extent which may lessen the patient's chances of recovery after formidable operations and increase the risk of pulmonary complications. Warm vapour less irritating to inhale; less secretion of mucus and saliva.

DISADVANTAGES.—Difficulty in securing sufficiently deep narcosis in the case of robust subjects. Too much heat produces sweating and flushing of the face and neck, and an unusual amount of bleeding in the wound due to the dilatation of the cutaneous vessels. A certain amount of practice is required to get the best results.

THE CLOSED METHOD.—

A Clover's inhaler or one of its modifications.

A closely-fitting pneumatic face-piece, connected with a rubber bag by a hollow shaft which passes through a metal chamber containing ether.

Adjustment is possible, so that the patient breathes air alone or varying mixtures of air and ether vapour.

TECHNIQUE.—

Clean and blow up the face-piece.

Allow breathing of simple air without the bag.

Allow breathing in and out of the bag without ether.

Turn on the ether gradually.

Hold the face on one side to allow for escape of saliva.

Moderate cyanosis may be ignored until the patient is under full anæsthesia.

After anæsthesia has become complete, allow one breath of air for every five inspirations.

For prolonged maintenance of anæsthesia the indicator should be kept at the lowest possible proportion of ether.

SYMPTOMS.—

FIRST STAGE—ANALGESIA.—Swallowing, cough, holding the breath. Pulse accelerated. Pupils large and mobile. Considerable degree of analgesia which will permit of simple surgical procedures.

SECOND STAGE—LIGHT ANÆSTHESIA.—Unconsciousness. Loss of memory, intelligence, and volition. Struggling, shouting. Clonic contractions or tremor. Flushed face, with sweating. Pulse is quick and full. Breathing often embarrassed by muscular spasm.

THIRD STAGE—FULL ANÆSTHESIA.—Loss of corneal reflex. Muscular relaxation. Breathing regular and stertorous. Pupils moderately dilated; respond to light. Superficial vessels are dilated, and those of the head and neck especially so.

FOURTH STAGE—OVERDOSE.—Pupils widely dilated and immobile. Complexion of dusky pallor. Respiration shallow, irregular, or jerky. The circulation fails considerably later than the respiration.

COMPLICATIONS.—

ASPHYXIA apart from overdose.

Is due to falling back of the tongue or jaw, spasm of the larynx or spasm of the respiratory muscles, inhalation of blood, mucus, or foreign bodies.

Respiratory embarrassment is well marked, and the complexion becomes livid.

Administration of Chloroform.—

PHYSICAL PROPERTIES.—Chloroform (CHCl_3) is made from rectified or from methylated spirit; either variety being equally good for anæsthetics (Hewitt). Sp. gr. 1.49. Neutral to litmus. No residue on evaporation. No colour when mixed with pure sulphuric acid. No precipitate with silver nitrate.

APPARATUS.—

A towel or lint mask. A drop-bottle.

Complicated apparatus, of which Harcourt's is the best known, aim at providing a vapour which contains a definite percentage of chloroform. Such apparatus, besides being expensive and liable to get out of order, present great difficulty in the induction of anæsthesia. They can never supply the place of experience and care on the part of the anæsthetist.

TECHNIQUE.—

PATIENT MUST BE LYING DOWN. Otherwise, when anæsthesia is induced, the blood is apt to gravitate to the lower part, and so by cerebral anæmia syncope is induced.

Chloroform is put inside the mask at the rate of 20 to 30 drops, freely diluted with air, every thirty seconds until anæsthesia is attained.

Anæsthesia is maintained by giving the minimum quantity necessary every half minute.

THE CONDITION OF THE PATIENT is watched with minute care, especially as regards respiration, pulse, colour, and pupils, throughout the entire anæsthesia.

SYMPTOMS AND SIGNS.—

FIRST STAGE—ANALGESIA.—Restlessness, sighing, coughing. Flashes of light and noises in the ears. Sense of exhilaration and tingling. Some analgesia without unconsciousness.

SECOND STAGE—LIGHT ANÆSTHESIA.—Unconsciousness. Struggling. Some irrational talking. Flushing of the face. Pupils dilated and reacting to light.

THIRD STAGE—FULL ANÆSTHESIA.—Breathing quiet and regular. Pupils contracted. They react sluggishly to light. The corneal reflex is absent. The eyes rotate downwards. The muscles are relaxed. The pulse remains normal in rate, but is more compressible.

FOURTH STAGE—OVERDOSE.—This is the state of danger, and should never be induced purposely. The respiration becomes irregular or ceases. The pulse is feeble, irregular, or imperceptible. Pupils are widely dilated and do not react to light. Complexion is dusky or deadly pale. It is apt to occur suddenly from overdose at the beginning.

PHYSIOLOGY.—A momentary stimulation is followed by a lasting depression of the nerve centres. The highest cerebral centres are affected first. The lower centres in the medulla are affected later. When pushed to a fatal degree, paralysis of the respiratory centre occurs first and of the cardiac centre next.

THE PUPIL DURING CHLOROFORM ANÆSTHESIA.—

Dilatation occurs first from stimulation of the sympathetic.

The pupil still reacts to light.

Contraction occurs later, when the sympathetic is paralysed, from stimulation of the oculomotor centre.

Dilatation occurs from paralysis of the oculomotor centre.

The pupil does not react to light.

DILATATION OF THE PUPIL occurs from five causes :—

- | | |
|---------------------------|--------------------------------------|
| 1. Incomplete anæsthesia | } The pupil reacts to light. |
| 2. Vasomotor depression | |
| 3. Vomiting | } The pupil does not react to light. |
| 4. Overdose of chloroform | |
| 5. Asphyxia | |

THE DILATED PUPIL WHICH DOES NOT REACT TO LIGHT is the most important and most urgent sign of grave danger. The pupil resembles the atropine pupil, being very widely dilated and quite immobile. It occurs in three conditions :

1. OVERDOSE, especially in chloroform anæsthesia.
2. ASPHYXIA of high degree, such as is seen occasionally when mouth gag has to be used throughout operation.
3. REFLEXLY from an operative procedure, e.g., stretching the sphincter ani.

TREATMENT.—Stop the anæsthetic and be prepared to begin artificial respiration at once, directly the signs of respiratory failure occur.

CESSATION OF RESPIRATION.—

CAUSES.—

1. Muscular spasm, with clenched jaw and fixed chest.
2. Tongue falling back so as to obstruct the upper aperture of the larynx.
3. Spasm of the glottis, especially in children.
4. Entry of blood, mucus, saliva, or foreign bodies into the larynx.
5. Overdose of chloroform.

OTHER COMPLICATIONS.—

CONDITIONS ASSOCIATED WITH PARTIAL ANÆSTHESIA, in which treatment consists in pushing the anæsthetic :—

1. Fright in nervous people.
2. Actual or threatened vomiting.
3. Syncope due to reflex inhibition resulting from some operative manipulation. In this the further pushing of the anæsthetic would only be done on recovery from the syncope.

Administration of Chloroform, *continued*.

CONDITIONS ASSOCIATED WITH FULL ANÆSTHESIA in which the treatment involves cessation of the anæsthetic :—

4. Partial asphyxia. The circulatory failure being secondary to the respiratory.
5. Shock or hæmorrhage of the operation.
6. Overdose of anæsthetic, especially chloroform.

CAUSES OF DEATH UNDER CHLOROFORM.—

1. Overdose in the early stages acting on an anæmic or asthenic heart during the struggling stage—the common cause. THE STATUS LYMPHATICUS is one in which this early sudden death is specially apt to occur. It consists in an enlargement of the thymus and of the lymphatic glands. Its existence cannot be recognized ante mortem.
2. Overdose during a long operation.
3. Syncope from the upright position of the patient.
4. Reflex cardiac inhibition during light anæsthesia, e.g., in dilating the anus or in castration.
5. Asphyxia due to causes other than chloroform overdose.
6. Late chloroform poisoning by the development of acid intoxication.

Comparison of Chloroform and Ether.—**ADVANTAGES OF CHLOROFORM.—**

1. FACILITY OF ADMINISTRATION.—No special apparatus is necessary. It is easy to give and pleasant to take.
2. COMPLETENESS OF MUSCULAR RELAXATION.—This is specially noteworthy in abdominal operations, when the quiet shallow breathing and the relaxation of the parietes make manipulation easy.
3. ABSENCE OF IRRITATION OF THE RESPIRATORY ORGANS.—This gives it its value in children and old people who are liable to bronchitis, and in all who are suffering from disease of bronchi, lungs, or pleuræ.
4. ABSENCE OF VENOUS CONGESTION.—Hence its special use in cerebral surgery.
5. NON-INFLAMMABLE AND LESS VOLATILE THAN ETHER.

DISADVANTAGES OF CHLOROFORM.—

1. IT IS TEN TIMES MORE TOXIC THAN ETHER, and the death-rate from its use is ten times as high (1 in 1000 cases compared with 1 in 10,000).
2. ITS LETHAL EFFECTS ARE OFTEN PRODUCED SUDDENLY, with little or no warning, and may therefore occur with the most careful administration.
3. ITS ACTION AS A PROTOPLASMIC POISON, producing death by acid intoxication.

ADVANTAGES OF ETHER.—

1. THE SAFETY OF ITS ADMINISTRATION, being ten times less toxic than chloroform.
2. THE DANGERS HAVE WELL-MARKED SIGNS, consisting in obvious respiratory embarrassment, which cannot be mistaken by the most careless or inexperienced.
3. THE DANGER PERIOD IS OF COMPARATIVELY SLOW ONSET, giving ample time for remedial measures.

DISADVANTAGES OF ETHER.—

1. THE DIFFICULTIES OF ADMINISTRATION. It is unpleasant to take, and requires the knowledge of some apparatus.
2. IRRITATING EFFECTS ON THE RESPIRATORY ORGANS, with a tendency to production of bronchitis and pneumonia.
3. EXAGGERATED RESPIRATORY MOVEMENTS which embarrass thoracic and abdominal operations.
4. FREQUENT WANT OF COMPLETE MUSCULAR RELAXATION.
5. TENDENCY TO VENOUS CONGESTION, especially in the region of the head and neck.

After-effects of Ether and Chloroform.—

VOMITING.—

SLIGHT VOMITING on return of consciousness is to be regarded as normal, and is a sign of reaction from shock of operation.

SEVERE VOMITING may be due to : (1) Idiosyncrasy or digestive disturbance; (2) Prolonged chloroform anæsthesia; (3) Ether anæsthesia when accompanied by prolonged partial asphyxia; (4) Acid intoxication; (5) Peritonitis, intestinal obstruction, etc.

TREATMENT OF SEVERE VOMITING (apart from disease).—

1. Wash out stomach, or give unlimited water to drink, which has the same effect.
2. Feed by rectum. Continuous saline infusion is specially valuable, because it promotes toxic elimination.
3. Drugs by mouth are useless. Morphia is dangerous because it checks elimination and paralyses the intestine. It should only be given in certain obviously neurotic cases. Iodine, ℥x of tr. iodi, carbolic acid ℥j in glycerin and water, brandy ℥j with little hot water, black coffee, are usually given in response to patient's entreaty for 'something to take'.

BRONCHITIS AND LUNG COMPLICATIONS.—

FROM THE USE OF ETHER.—Ether acts as an irritant on the bronchi, and in susceptible people may cause slight bronchitis.

After-effects of Ether and Chloroform, Lung Complications, *continued*.

PRE-EXISTING LUNG DISEASE.—When ether is given to those with pulmonary congestion, bronchitis, or phthisis, it may bring about a severe or fatal bronchitis.

FROM ASPHYXIA.—If ether is given with insufficient air, the partial asphyxia is the most potent cause of bronchitis. Hence the semi-open method is better than the use of the inhaler.

FROM INFECTED INHALERS.—Severe septic bronchopneumonia following ether is probably due to infection from a septic inhaler.

ACID INTOXICATION.—

NAMES.—Acid intoxication, acidosis, acetonuria, is the same thing as ‘secondary chloroform poisoning’, and similar to the condition accompanying coma in diabetes.

PATHOLOGY.—Fatty degeneration of the liver, kidneys, and heart is an invariable factor. It may precede or be caused by the anæsthetic. The products of fat decomposition, notably acetone and diacetic acid, are found in the blood and urine. The nervous symptoms are due probably to some of these decomposition products. Defective elimination by the kidneys is a contributory factor.

CAUSES.—

IN FAT CHILDREN it may arise spontaneously without other disease, and cause recurrent attacks of vomiting.

DIABETES.—In this, the condition is seen in its most extreme form.

SEPSIS.—This is only a contributory factor when associated with one of the other causes.

TRAUMA.—Any severe operation in a diabetic, or patient with acid intoxication, may be followed by fatal acidosis.

CHLOROFORM.—This acts as a protoplasmic poison, and causes fatty degeneration of liver and kidney cells.

ETHER also may act in the same way, but not to the same extent as chloroform. Further, it does not paralyse the kidneys to the same extent; hence elimination of the poison is not interfered with.

COMBINED CAUSES.—The majority of fatal cases have occurred when chloroform has been given to fat children or diabetics, with pre-existing acidæmia, for a serious operation.

SYMPTOMS.—Copious, violent, and persistent vomiting, the vomit being like coffee-grounds or beef-tea dregs. Sweet smell to the breath. Slight icterus. Urine contains acetone or diacetic acid. Restlessness, delirium, ending in coma.

PREVENTION.—Avoid operating on patients with acidæmia when possible. Do not starve children for more than two hours before operation. Give barley-sugar. Use local or

spinal anæsthesia in such cases if possible. Use ether rather than chloroform in general anæsthesia if necessary.

TREATMENT.—Copious infusions of solution of sodæ bicarb. 3j to the pint, both intravenous and rectal.

Anæsthetic Sequences.—

GAS-ETHER. ETHYL-CHLORIDE-ETHER. — Both these have the advantage of abolishing the unpleasantness of the early stage of ether. The patient goes under much more quickly, quietly, and pleasantly.

ETHER-CHLOROFORM. — Anæsthesia induced with ether and continued with chloroform. This avoids the early period of chloroform administration during which the majority of fatalities occur, and secures the special advantages of chloroform for the operation. Used chiefly in abdominal cases.

Anæsthetic Mixtures.—

ALCOHOL, CHLOROFORM, AND ETHER, OR A.C.E., has 1 part alcohol, 2 parts chloroform, and 3 parts ether, by weight.

CHLOROFORM AND ETHER, OR C.E. MIXTURE, has 1 part of chloroform to 2 of ether.

These two may be considered as having an identical action and use, as the alcohol is negligible and is now usually omitted.

TECHNIQUE.—An open mask or Rendle's mask as in the semi-open ether method. About twice as much at a time is used as with chloroform.

ADVANTAGES.—It is essentially a chloroform anæsthesia, but the ether dilutes and also counteracts its depressing effects.

DISADVANTAGES.—The different rates of evaporation introduce an element of uncertainty. At first the patient gets nearly pure ether, later nearly pure chloroform.

Preparation of Patient for Anæsthetic.—

FLUID AND FOOD.—No food for six hours. A cup of tea, with glucose, within two hours may be allowed. Milk especially should be avoided, as it is not digested, and is then vomited in the form of hard curds. In cases where shock or hæmorrhage is anticipated, glucose solution given by the rectum is valuable.

BOWELS.—In all cases the rectum and large bowel should be emptied by an enema or aperient, but purgation in the sense of causing repeated watery stools is definitely bad.

BLADDER.—The bladder should always be emptied the last thing before the anæsthetic: if necessary, by catheter.

MOVING THE PATIENT.—The less the patient is moved after anæsthetizing the better. Hence the advantage of giving the anæsthetic on the operating-table. But with most patients the fear of the operating-room is more harmful than careful lifting. In lifting, the level supine position should be kept.

Preparation of Patient for Anæsthetic, *continued*.

TEETH AND TIGHT CLOTHES.—Artificial or loose teeth to be removed, and any tight bands taken from the neck, chest, or abdomen.

STOMACH.—In cases of intestinal obstruction or in cases of emergency operations when no preparation has been made, the stomach should be washed out just before or in the early stage of anæsthesia.

DRUGS.—In severe abdominal operations MORPHIA (gr. $\frac{1}{4}$ to $\frac{1}{2}$) lessens the amount of anæsthetic required, and also lessens the shock. SCOPOLAMINE, i.e., hyoscine hydrobromide, is often combined in $\frac{1}{10}$ -gr. dose with $\frac{1}{3}$ gr. of atropine, and given before major operations. STRYCHNINE (liq. strych. \mathbb{M} v) is given by some to counteract cardiac depression. CHLORETONE (gr. xv) is said to have a powerful effect in preventing post-anæsthetic vomiting in those who are known to be predisposed to this complication.

AVOID POSTURE PARALYSES.—

ERB'S PARALYSIS results when the arm is raised and fixed and the head turned to the opposite side. It is due to compression of the brachial plexus between the clavicle and 1st rib.

MUSCULOSPIRAL PARALYSIS is due to the arm being allowed to hang down over the side of the table, the table edge pressing against the inner and posterior surface of the humerus.

WARMTH.—The operating-room should be at least 70° F. Patient should be as warmly clad and as little exposed as possible. A flat rubber bag filled with hot water should be placed on the table for the patient to lie on, in desperate cases.

Treatment of Emergencies of Anæsthesia.—**1. VOMITING DURING INDUCTION.—**

Depress head well below level of trunk.

Of vital importance in cases of intestinal obstruction to avoid aspiration of vomit.

2. SYNCOPE OR CARDIAC FAILURE IN LIGHT ANÆSTHESIA.—

Depress the head lower than the trunk.

Strychnine (\mathbb{M} x hypoderm.), brandy (\mathfrak{J} j by rectum), ether (\mathbb{M} xv to xxx subcutaneously).

Artificial respiration.

If recovery takes place, the operation should not be resumed until full anæsthesia has been induced.

3. CARDIAC FAILURE IN FULL ANÆSTHESIA.—

Occurring suddenly early in chloroform anæsthesia the outlook is almost hopeless.

Occurring late in anæsthesia it should be recognized early enough to allow successful treatment.

Artificial respiration. Cardiac stimulants.

Direct heart massage through an epigastric incision.

4. RESPIRATORY EMBARRASSMENT WITH OBSTRUCTION.

REMOVE THE OBSTRUCTION.—Push the jaw forward. Open the mouth. Pull forward the tongue. Clear the fauces and pharynx with sponge on holder.

LARYNGOTOMY OR TRACHEOTOMY for cases where the above fails to relieve obstruction, cases due to laryngeal spasm, and those due to pressure upon or foreign bodies in the larynx and trachea.

ARTIFICIAL RESPIRATION.—Stand behind patient's head. Grasp elbows and pull them upwards, then press them down and in on the chest. About 15 times a minute. It is useless to do artificial respiration unless obstruction is removed and the air-way kept clear.

OXYGEN ADMINISTRATION combined with the above.

VENESECTON for stout plethoric persons in whom the asphyxia has caused marked venous engorgement, cyanosis, and cardiac embarrassment. Withdraw one pint of blood.

5. RESPIRATORY FAILURE apart from obstruction.—Rhythmical tongue traction. Artificial respiration.**The After-treatment of Anæsthesia.—**

NECESSITY OF CAREFUL WATCHING.—Restlessness, with falling out of bed; hæmorrhage, external or internal; moving of splints, bandages, and dressings; asphyxia, from the pharynx becoming full of vomit: such chances require THE CONSTANT PRESENCE OF A NURSE until consciousness is regained.

POSITION.—

THE HEAD IS TO BE KEPT LOW until shock has passed off.

THE HEAD TO BE KEPT ON ONE SIDE, to allow vomit to escape from the pharynx.

WARMTH.—Blankets and hot bottles. The latter must be outside the blankets and never touch the patient, otherwise burning may result.

STOMACH.—In cases of intestinal obstruction the stomach should be washed out before the patient leaves the table.

FEEDING.—Slight cases require no special rule.

WITHHOLDING FOOD.—In severe cases no solid food is to be given for several days. It is both useless and harmful, as the digestive processes are largely suspended.

GIVING LIQUIDS.—The old plan of withholding fluids is to be condemned as cruel, harmful, and irrational. The patient wants water, and should be allowed to drink it freely, and in whatever quantity. If vomiting is persistent, water should be given by the rectum. In stomach and œsophagus operations only is there any need for restriction.

After-treatment of Anæsthesia—Feeding, *continued*.

NATURE OF FOOD.—Plain milk and any food difficult of digestion are to be avoided. Peptonized milk, tea, meat extracts, barley-water, Benger's food must be given at discretion.

SOLID FOOD is usually given on the second or third day, after the bowels have acted.

II. RECENT MODIFICATIONS OF GENERAL ANÆSTHESIA.

INTRAVENOUS ETHER.—

A 5 per cent solution of ether in normal saline is injected continuously into a vein during the whole operation; 3 to 4 pints is probably the maximum permissible.

ADVANTAGES.—There is no irritation of the lungs or bronchial mucosa; the dose of anæsthetic is the minimum required; convenient in operations about the head, as the anæsthetist is away from the surgeon; consciousness is quickly regained; after-vomiting is trivial; the transfusion improves the condition of those with great cachexia.

DISADVANTAGES.—The necessity of the preliminary operation for finding the vein; the possibility of thrombosis in the vein; the danger of drowning the patient (i.e., overwhelming the lungs and kidneys) with the excess of fluid; the bleeding and oozing from the wound area are increased, and bleeding from a quiescent focus may be re-started.

RECTAL ETHER.—An aperient is given the night before, an enema four hours before operation; the colon is washed out two hours before operation; one hour later morphia and atropine are given hypodermically. Half an hour before operation the oil-ether is introduced per rectum. The oil-ether mixture consists of equal parts of olive oil and ether, thoroughly shaken up together. It is introduced by inserting a soft rubber catheter 5 inches up the rectum, allowing the mixture to enter at the rate of 1 oz. per minute. Use 1 oz. of the mixture to 20 lb. of body weight; maximum to be introduced, 8 oz. Short inhalations of ether may be required to get over the excitement stage. After operation, wash out the colon with plain water; 2 to 4 oz. of olive oil are put in and retained.

ADVANTAGES.—In operations on the head and neck and upper air-passages, the very obese, thyroidectomy, gastric cases.

DISADVANTAGES.—Amount of time required over the preliminary technique, unless the cases can be entrusted to assistants or nurses until the moment of operation, which is obviously difficult, seeing that all the important steps are taken prior to this. Just as much care must be taken to prevent mechanical obstruction to the upper air-passages as in inhalation anæsthesia. Fatalities are recorded.

AVERTIN (tri-bromethanol), administered in solution per rectum, acts as a basal anæsthetic, producing deep unconsciousness for several hours, and requires only small quantities of inhalation anæsthetic (ether) to obtain full muscular relaxation.

INTRATRACHEAL ETHER INSUFFLATION.—

METHOD.—After preliminary general anæsthesia the larynx is cocaineized and a flexible catheter (21 to 24 French gauge) passed through the glottis until its end is 26 cm. from the teeth, i.e., at the bifurcation of the trachea. A warmed mixture of air and ether vapour is pumped in by a continuous current at a positive pressure of about 10 mm. Hg. Respiratory exchange will then occur with very slight respiratory movements.

ADVANTAGES.—It has all the advantages of a positive pressure apparatus, so that the chest can be fully opened without collapse of the lungs; it secures a free and unobstructed air-way, so that cyanosis cannot occur; it overcomes the possibility of obstruction by the upper air-way; respiratory movements are diminished to those of the quietest sleep; it is of great value when the trachea is obstructed, e.g., in goitre cases; it diminishes shock by relieving both respiration and circulation from the strain caused by usual anæsthesia; the constant stream of air escaping from the larynx prevents blood, mucus, or vomit from trickling down into the trachea.

DISADVANTAGES.—The difficulty of passing a catheter through the glottis and the possibility of damage—this is only a matter of experience; the danger of injury to the lungs or surgical emphysema by too high a pressure—this can be prevented by a safety valve in the apparatus which blows off at 15 to 20 mm. of mercury.

III. LOCAL ANÆSTHESIA.

Drugs used.—

COCAINE HCl.—Not used now as a hypodermic because of the danger of toxic effects. Used for ophthalmic work as a 5 per cent solution for instillation into the conjunctival sac, and sometimes as a throat spray.

EUCAINE.—Dose up to gr. iij. Soluble up to 1–20 (5 per cent). It is more irritating to mucous membranes than cocaine, but is much less toxic.

NOVOCAIN.—Dose up to gr. v; gr. j is sufficient for small operations. Is practically non-toxic, and therefore should always be used for injection methods. Used as a 1 or 2 per cent solution.

COMBINATIONS WITH ADRENALIN.—An addition of 10 to 20 min. of adrenalin solution (1–1000) to the dose of any of the above causes marked vasoconstriction, and thus a limiting of the action of the solution to the part injected.

Local Anæsthesia—Combinations with Adrenalin, *continued*.

Adrenalin solutions cannot be boiled. They must be added after the other solution has been sterilized.

BARKER'S SOLUTION.—Eucaine, gr. iij; sod. chloride, gr. xij; aq. dest., ℥iiss; sol. adrenalin, ℥xviij. Up to ℥ij of this may be used.

Methods and their Application.—

INSTILLATION.—A few drops of 5 per cent cocaine solution placed on the conjunctiva render the latter and the cornea insensitive. Used for ophthalmic operations.

SPRAYING AND SWABBING.—Cocaine 5 to 10 per cent solution, usually with adrenalin, sprayed or painted on to the nasal, pharyngeal, or laryngeal mucous membrane.

NOSE.—For all intranasal operations which only involve the mucous membrane. The marked shrinkage of the swollen membrane makes the parts easily visible and reduces hæmorrhage.

THROAT.—As a preliminary to laryngoscopy and for small operations.

LARYNX.—For intralaryngeal operations, e.g., scraping tuberculous nodules or removal of papillomata.

SUBCUTANEOUS INJECTION.—Eucaine or novocain should always be used, and cocaine definitely abandoned because of its dangerous toxicity. ℥j to ij of a 5 per cent solution of eucaine or novocain is injected beneath the skin which is to be incised. It ought to be used with the infiltration method, or as

REGIONAL ANÆSTHESIA.—In this the drug is injected over a wide area, especially IN THE COURSE OF THE NERVE TRUNKS supplying the part. Examples:—

FOR GOITRE.—Through two or three punctures the whole circumference of the goitre is infiltrated with a 1 per cent solution of novocain without adrenalin. After waiting 10 minutes the skin incision is made, and the first stages of dissection are carried out. Then more of the solution is injected at the sides of the larynx and trachea.

FOR HERNIA.—The solution is injected on the inner side of the iliac spine as well as over the hernia, so as to paralyse the sensory nerves (ilio-inguinal, etc.).

FOR FINGER OPERATIONS.—An elastic ligature is placed round the finger at its base to further limit and intensify the action of the anæsthetic.

SPLANCHNIC ANÆSTHESIA.—This is used for operations on the upper abdomen, especially those on the stomach. The splanchnic nerves are given off from the lower thoracic sympathetic ganglia (great splanchnic 5 to 10, lesser splanchnic 10 and 11,

lowest splanchnic 12) and pierce the crus of the diaphragm to join the cœliac ganglion. They are injected with 2 per cent novocain by a needle 12 cm. long thrust into the angle below the last rib, or through the abdominal incision from the front.

INFILTRATION METHOD (Schleich).—In this the solution is injected into the deep layers of the skin, and not beneath the skin. Schleich's solutions contain from gr. $\frac{1}{10}$ to gr. 1j cocaine with gr. $\frac{1}{2}$ morphia and gr. 1j sodium chloride in $\frac{5}{8}$ ij of water. The needle is driven horizontally into the skin, and successive drops are injected along the site of the incision as the needle is withdrawn. It is painful and difficult to execute accurately.

Freezing Methods.—Ice and salt mixture, and the ether spray, applied to a part, cause freezing of the skin with anæsthesia, but the former is clumsy, and the latter very painful after the cold passes off.

ETHYL CHLORIDE SPRAY is the only freezing method used. The spray from a special phial is directed on to the site of the incision until the latter is frozen.

APPLICATION.—Opening superficial abscesses.

IV. SPINAL ANÆSTHESIA.

Although the scope of this method is not nearly so great as it promised to be on its introduction, it has undoubtedly a most valuable place among anæsthetics. It is impossible, however, yet to decide what is its mortality compared with general anæsthesia, because : (a) Many thousands of cases are necessary for comparison ; (b) Spinal anæsthesia, in this country at any rate, is limited to cases of special gravity, whilst general anæsthesia is used for all trivial operations. Hence, what follows must be accepted with the limitations here suggested.

Drugs used.—

COCAINE HCl.—This was the drug first used, but is now abandoned because of its immediate danger and severe after-effects.

STOVAINE.—This is the drug most commonly used. It is much less toxic than cocaine.

DOSE.—Gr. iss, or 0.1 grm., or 1 c.c. of 10 per cent solution.

BARKER'S STOVAINE SOLUTION.—0.05 grm. stovaine, 0.05 grm. glucose, to 1 c.c. water. The glucose is added to make a heavy solution which will remain in the lower part of the spinal theca.

LIGHT STOVAINE.—Made up with normal saline instead of glucose, so that it is of lower specific gravity than the cerebrospinal fluid. It is used for abdominal operations—e.g., excision of the rectum—where the patient is placed in the high pelvic position, in which position heavy stovaine would gravitate to the medulla.

Spinal Anæsthesia.—Drugs used, *continued*.

NOVOCAIN.—Dose, gr. ij in 10 per cent solution.

SPINOCAIN.—A solution of novocain and strychnine in a special solvent. It is of lighter specific gravity than the cerebrospinal fluid, and owing to its viscous character it does not diffuse, but floats like a bubble in the spinal fluid; it must therefore *never be given with the patient in the sitting posture*. The anæsthesia produced is controllable, and may be confined to the perineum or legs, carried to the umbilicus, or extended to the costal margin, according to the degree of the Trendelenburg position. Spinocain is practically non-toxic, and does not materially lower the blood-pressure.

Method.—

POSITION.—Patient seated with bent back, except when spinocain is used. In cases of prostration, or if spinocain is employed, the patient lies on his side. The shoulders are kept raised throughout the operation, to hinder the spreading of the solution to the medulla—except again when spinocain is used, when the head and shoulders must be kept *below* the level of the trunk.

PREPARATION.—Skin is cleansed over the seat of puncture.

NEEDLE.—A needle $\frac{1}{4}$ in. long, with a stylet and multiple openings, is necessary to prevent clogging by fat or blood-clot.

PUNCTURE.—Strictly in the mid-line of the back between the 3rd and 4th lumbar spines. This is on a line joining the highest points of the iliac crests (*Fig. 25*).

ENTERING THE THECA.—The needle is manoeuvred between the laminae and then pushed on for about $\frac{1}{2}$ in. The stylet is withdrawn, and the spinal fluid ought to flow. If it does not it is useless to inject the fluid.

PUNCTURE WOUND is closed with collodion.

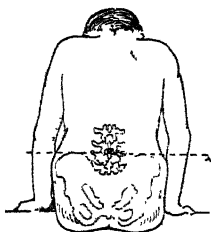


Fig. 25.—Position for puncture in spinal anæsthesia. Spot between 3rd and 4th lumbar spines at level (A) of iliac crests.

Results.—

ANALGESIA occurs in 10 minutes.

LOSS OF PAIN AND TEMPERATURE SENSE is complete in most cases.

TACTILE SENSATION is not abolished, so that the patient feels the manipulations.

REFLEXES are lost in the legs and lower abdomen.

RECTUM AND BLADDER.—Involuntary micturition and defæcation occur rarely.

THE MOTOR POWER is partly or completely paralysed in the legs and lower abdomen.

LIMITS OF ANÆSTHESIA.—Usually this affects the regions supplied by the lumbar and sacral nerves only. The whole of the legs and the abdomen below the navel are analgesic. Occasionally the upper limit reaches the ensiform cartilage or the nipples. It is claimed for sponocain that reliable anæsthesia can be obtained in the upper abdomen, without danger to the medullary centres.

DURATION.—About one hour.

PULSE AND RESPIRATION are unaffected, or they may become slower.

BLOOD-PRESSURE is definitely but only slightly lowered at the time by even severe operations in the absence of hæmorrhage, thus showing that shock is prevented. But if the blood-pressure is already low, then a serious fall takes place.

After-effects.—

WITH COCAINE.—Severe headache, backache, some vomiting, rise of temperature to 102° F.

These after-effects more than counterbalance the advantage to the patient of escaping the unpleasantness of general anæsthesia.

WITH STOVAINE.—The after-effects are slight and transitory. Headache and vomiting.

EXCEPTIONAL SEQUELÆ.—Various paralyses, especially of the oculomotor nerves. Paraplegia of a transitory character.

Advantages of Spinal Anæsthesia.—

1. If the patient's general condition is good at the time of operation, then much less shock occurs at the time, and anti-shock treatment will then prevent secondary shock—e.g., in excision of the rectum or amputation of the thigh for sarcoma. But if the patient is already shocked, then it is most dangerous—e.g., in amputation of the thigh after a gunshot wound or injury.
2. It does not require special preparation of the stomach and bowels.
3. In desperate operations likely to terminate fatally the patient does not die on the table and does not lose consciousness.

Advantages of Spinal Anæsthesia, *continued*.

4. Very rarely a patient refuses to take a general anæsthetic, but will submit to a spinal injection.
5. In certain conditions, e.g., diabetes or acidosis, it is less dangerous than a prolonged general anæsthetic.

Disadvantages of Spinal Anæsthesia.—

1. IT FAILS IN SOME CASES.—In a varying proportion (5 to 10 per cent) the spinal theca cannot be penetrated satisfactorily, and in these the anæsthesia is impossible. This is most likely in old, feeble, and emaciated patients.
2. THE PAIN OF THE PUNCTURE AND THE ALARM to nervous people, conscious of the operation.
3. THE RISK OF MENINGITIS OR LATE PARALYSIS.—This is very slight.
4. IN MILITARY SURGERY, it has been found that when profound shock already exists, the use of spinal anæsthesia is followed by a serious fall of blood-pressure which often proves fatal.

Indications for Use.—Operations below the umbilicus in which some of the following exist :—

1. Operations involving severe shock, e.g., amputation through the hip in debilitated subjects.
2. Diabetes, especially with acetonuria.
3. Certain conditions of heart weakness.
4. Desperate cases of intestinal obstruction with constant vomiting. (This condition may be dealt with by the intratracheal method, p. 115.)
5. Operations performed *in extremis*.
6. When the patient refuses to take a general anæsthetic.

CHAPTER XIII.

INJURIES OF BLOOD-VESSELS.

HÆMORRHAGE.

Symptoms.—

1. AFTER SUDDEN LARGE HÆMORRHAGE.—

PALLOR of surface and of mucous membranes.

LIVIDITY exists if sudden death has followed wound of a large artery, because there has been no time for veins and capillaries to empty.

RESPIRATION quick, sighing, and gasping.

PULSE rapid, small, and weak.

NOISES heard in ears.

DIMNESS OF VISION with flashes of light.

SYNCOPE, nausea, loss of consciousness.

RESTLESSNESS.

SURFACE IS COLD.

SWEATING is abundant.

SUBNORMAL TEMPERATURE.

GREAT THIRST.

2. AFTER RECURRENT SMALL HÆMORRHAGES.—

ŒDEMA of eyelids and extremities.

LIABILITY TO FAINT on slight exertion.

PULSE is quick and easily compressible, with full beat and empty artery between beats, and well-marked dicrotic wave.

A TENDENCY FOR ALL THE SYMPTOMS TO INCREASE as bleeding continues.

Blood shows LEUCOCYTOSIS and diminution of red cells and hæmoglobin.

After hæmorrhage has ceased, especially concealed hæmorrhage, TEMPERATURE rises to 101°–102° F. for one or two days.

Circumstances which Modify the Effects of Hæmorrhage.—

QUANTITY of blood lost.

RATE of loss.—The sudden loss of a comparatively small quantity is more dangerous than the gradual loss of a much larger quantity.

AGE.—Infants and aged patients bear loss of blood badly.

SEX.—Women are less affected than men.

CONSTITUTIONAL CONDITION.—The following render bleeding much more serious: Pre-existing Anæmia; any Asthenic or Cachectic Disease; MARASMUS; co-existent SHOCK; SEPSIS.

Circumstances which Modify the Effects of Hæmorrhage, *continued*.

IN OPPOSITE CONDITIONS, notably in plethoric individuals with high-tension pulse, or any cause of visceral congestion, cerebral or pulmonary in particular, BLEEDING MAY BE POSITIVELY BENEFICIAL.

Diagnosis of Hæmorrhage (especially concealed hæmorrhage).—

IN SHOCK.—

SYMPTOMS are at their worst immediately after the injury, and TEND TO IMPROVE with time, except in fatal cases.

NERVE SYMPTOMS are much more prominent from the first : Unconsciousness, flaccid limbs, pupils dilated.

IN CEREBRAL CONCUSSION.—

Symptoms are of SUDDEN ONSET.

UNCONSCIOUSNESS is well marked and out of all proportion to the circulatory depression.

HISTORY of blow on the head.

IN CEREBRAL COMPRESSION.—

PARALYSIS and coma.

RESPIRATIONS are deep and noisy.

SKIN is hot and congested.

PUPILS are often unequal.

PULSE is slow and forcible

IN HÆMORRHAGE, on the other hand,—

SYMPTOMS are trivial at first and increase in severity gradually. Pallor, restlessness, dyspnœa, and thirst are conspicuous before unconsciousness occurs.

(For the diagnosis of abdominal, thoracic, and joint hæmorrhage, see the respective sections.)

The Arrest of Hæmorrhage always consists of two stages:—

1. TEMPORARY.—The stopping of the bleeding. This can be NATURAL OR ARTIFICIAL.
2. PERMANENT.—The repair of wounded vessels. This is always a vital process, and nothing artificial can take its place.

Natural Temporary Arrest of Hæmorrhage.—

IS BROUGHT ABOUT BY :—

THE CONTRACTION of the ends of the vessel.

THE RETRACTION of the vessel in its sheath.

CURLING UP of inner coats within the outer.

COAGULATION of blood in and round the end of the vessel.

An internal clot forms between the nearest branch and the cut end of the vessel.

A central clot forms in the lips of the cut vessel.

An external clot forms outside the cut end of the vessel and between the middle coat and the sheath.

IS AIDED BY :—

CONTUSION OR LACERATION of the vessel. This increases contraction and retraction of the coats.

DIMINISHED BLOOD-PRESSURE. Bleeding generally stops when the patient faints

INCREASED COAGULABILITY of the blood. This occurs in anæmia; in asphyxia; after taking much milk, lime salts, or magnesium carbonate; when fluids are restricted.

IS RETARDED BY :—

CLEAN-CUT wounds.

PARTIAL DIVISION of vessels, preventing contraction and retraction of vessel.

INCREASED BLOOD-PRESSURE: Renal disease; plethora; inflammation and congestion; exercise.

MOVEMENT of the part.

STIMULATION OF THE HEART (by drugs, alcohol, etc.).

HÆMOPHILIA.

CHRONIC JAUNDICE.

DIMINISHED COAGULABILITY OF THE BLOOD: Vegetarian diet; diminution of lime salts; citric acid; large quantities of fluid; restriction of food.

The Permanent Arrest of Hæmorrhage.—Produced by :—

HEALING OF THE WOUNDED VESSELS.—

The clot becomes contracted and fissured.

The vasa vasorum dilate and exude plasma and white corpuscles.

The wall of the blood-vessel is thus swollen and more vascular.

The clot is penetrated by leucocytes and fibroblasts, the latter formed by proliferation of endothelium.

The fissures in the clot are lined by proliferating endothelium, thus forming new capillaries.

The capillaries communicate with (a) The lumen of the vessel;

(b) The vasa vasorum.

The clot and the vessel wall eventually become organized into fibrous tissue.

DIFFERENCES IN HEALING OF ARTERIES AND VEINS.—

IN AN ARTERY.—A lateral wound does not heal until the lumen of the vessel is obliterated, because the high blood-pressure displaces the clot. When the lumen is once obliterated it is seldom opened up, because the thick arterial wall actively contracts and forms a strong scar.

IN A VEIN.—A lateral wound, when once it is plugged by clot, heals. The blood-pressure is too low to disturb the clot.

When a vein is obliterated by thrombosis, it often becomes re-canalized.

The Surgical Arrest of Hæmorrhage is brought about by closing the mouths of wounded vessels and holding them closed until they are plugged by firm clot. The following methods are employed :—

1. PRESSURE.—

AS THE PRELIMINARY to other means: On the artery at a distance from the wound. On the bleeding point.

Surgical Arrest of Hæmorrhage—Pressure, continued.

AS THE SOLE MEANS of arrest: Capillary or parenchymatous bleeding; bleeding from a superficial vein; bleeding in a bony cavity; bleeding from a hollow organ or cyst; deep hæmorrhage where ligature cannot be applied.

ITS DANGERS in other cases are: Inefficiency; Gangrene; Conversion of open into concealed hæmorrhage.

2. **FORCEPS.**—As a preliminary to ligature; as a sole means in small vessels. Causes adhesion of lips of vessel and curling up of inner coats.

3. **CLAMPS.**—

RAPID METHOD.—A vascular pedicle is crushed and its vessels obliterated at one stroke, e.g., pedicles of polypi, appendix vermiformis.

SLOW METHOD.—Clamps are left on for 48 hours. On inaccessible structures, e.g., pedicles of renal tumours and broad ligament of uterus.

4. **TORSION.**—Vessel is twisted 8 half turns of the forceps. Inner coats curl up inside lumen. Outer coats twist up as a knot outside.

5. **LIGATURE.**—The method of choice in most cases (*see* **LIGATURE OF ARTERIES**).

6. **CAUTERY.**—Causes great contraction and retraction of vessels. A dull red heat only is essential, otherwise the vessel will be clean cut.

Is **ESPECIALLY USEFUL**: In parenchymatous bleeding; in bleeding from a sloughy surface; in internal piles.

7. **COLD** causes contraction of small vessels. Sucking ice for bleeding from mouth, throat, and stomach. Iced douches for epistaxis. Ice compress over a bleeding viscus; e.g., in hæmatemesis.
8. **HEAT** acts in the same way as cold. Hot water should be between 120° and 150° F. Useful for large bleeding surfaces, e.g., uterus, bone cavities, and cysts.
9. **STYPTICS**, e.g., alum, perchloride of iron, and tannic acid. They hasten coagulation of the blood. Very unreliable. Small wounds of the face, capillary oozing in mouth or nose, fungating tumours.
10. **SUPRARENAL EXTRACT** as a local injection or application. Injection up to 10 min. of 1-1000 adrenalin chloride. Causes contraction of small vessels. Is generally used in conjunction with eucaine as a preliminary to superficial operations.
11. **ERGOT**, administered by mouth or as a hypodermic injection. Used for post-partum hæmorrhage. Causes the uterus to contract as well as its vessels.
12. **HÆMOSTATIC SERUM—HÆMOPLASTIN.**

Treatment of the Effects of Hæmorrhage.—

REST—local and general.

KEEP THE HEAD LOW—to prevent syncope.

WARMTH—by blankets and hot bottles.

INFUSION OF SALINE FLUID (sodium chloride 3j to Oj).—

INTO A VEIN.—Use 2-4 pints. Inject into a superficial vein, e.g., median basilic. Temperature 100° F. Avoid injecting air.

SUBCUTANEOUS.—Into the tissues under the mamma or axilla.

Specially suitable for cases where assistance is unavailable.

CONTINUOUS TRANSFUSION.—The saline solution is allowed to continue running into the subcutaneous tissue, or into the rectum, slowly for 12-24 hours, using 6-10 pints of fluid.

INFUSION OF SOLUTION OF GUM ACACIA.—A 6 per cent solution of gum acacia in normal saline gives a more lasting result than saline alone. But opinion is sharply divided as to its real value.

BLOOD TRANSFUSION.—The ideal method of treating anæmia.

CHOICE OF A DONOR.—Blood contains hæmolysins and agglutinins which may cause dangerous clotting if a suitable donor is not selected. All people fall into one of four groups as regards the properties of their blood. It is only necessary to test for agglutination, as this precedes hæmolysis.

TABLE I.

Group	Incidence	Serum agglutinates cells of group	Cells agglutinated by serum of group
1	3 per cent	0	2, 3 and 4
2	41 "	1 and 3	3 and 4
3	13 "	1 and 2	2 and 4
4	43 "	1, 2 and 3	0

To discover to which group a person belongs, test against serum of Groups 2 and 3. On one end of a slide place a drop of Group 2 serum, at the other end a drop of Group 3 serum. Add to these, with separate match-sticks, a drop of the blood to be tested, and stir well. If clumping takes place, in either or both, it does so within two or three minutes, giving a coffee-grounds appearance.

TABLE II.—CLUMPING.

Group	With Serum 2	With Serum 3
1	Yes	Yes
2	No	Yes
3	Yes	No
4	No	No

Group 4 is universal donor ; Group 1 universal receiver.

For routine emergency work it is convenient to have several donors of robust physique belonging to Group 4 available, so that no preliminary testing will be necessary.

Blood Transfusion, *continued*.

DIRECT METHOD.—A direct union is made between the radial artery of donor and basilic vein of patient by means of a rubber tube fitted with two cannulas, and lined throughout with paraffin. This is almost entirely abandoned on account of the difficulty of technique, and of measuring the blood passed.

UNMODIFIED BLOOD : KIMPTON'S METHOD.—A glass cylinder with the lower end drawn out to a point, and capable of holding about a pint, is used. At the upper end a cork with a glass tube is fitted, to which a small air-pump—such as is used on a scent spray—is attached after the receptacle is filled. The cylinder is lined with a film of paraffin by melting a piece of embedding paraffin in it over a flame, and gradually coating the surface. A superficial vein is dissected out in both donor and recipient. The cannula of the receiver is inserted into the lumen of the vein, pointing distally, after a light tourniquet has been applied (*Fig. 26*). The donor alternately clenches and relaxes his fist, and a pint of blood is easily collected. The rubber tube of the air pump is now fixed in position; the cannula is rapidly transferred to the lumen of the recipient's vein and pointed proximally, and air pumped into the cylinder steadily forces the blood

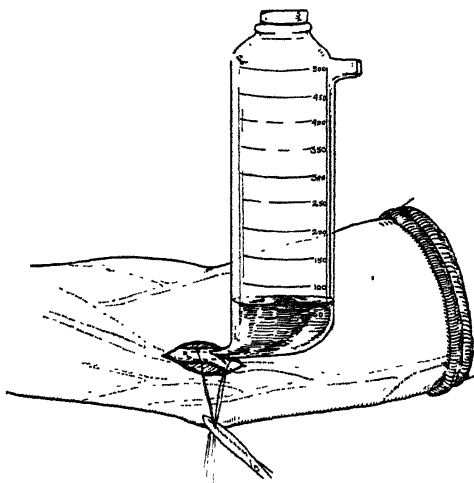


Fig. 26.—Blood transfusion. Collection of blood from donor. The point of the cylinder gently inserted in the vein, in the direction of the distal portion.

into the circulation. This may be repeated if donor's condition permits.

The advantages of this method are that the corpuscles are in a living condition, and the technique is simple; the only difficulty is in securing a suitable donor at the time wanted.

CITRATED BLOOD.—A litre bottle has 150 c.c. of isotonic sodium citrate solution placed in it. Blood is drawn from a distended vein by needle and cannula into the bottle, which is kept at blood heat. Shake the bottle continually as the blood flows in, till a pint has been taken. The citrated blood is given intravenously to the recipient through a needle and cannula by pumping air into the bottle on the principle of the wash-bottle.

The advantages urged for this method are that clotting is impossible. Unfortunately, in practice, this often occurs in the rubber tube. It is claimed that the blood can safely be kept in stock till required. This may result in the degeneration of the corpuscles and the waste of donor's blood.

RESULTS.—Blood-pressure readings after intravenous injections with saline, gum acacia, and fresh blood, show that saline raises the pressure for only two hours, when it falls down to, or even below, the original; gum acacia gives a raised pressure for about eight hours; while fresh blood effects an improved pressure for several days.

TRANSFUSION OF VASOCONSTRICTOR SOLUTIONS.—Adrenalin—Ergotinine—Pituitary gland extract. Raise blood-pressure, and therefore combat shock. Are unsuitable if the hæmorrhage is likely to recur.

RECTAL INJECTIONS.—One pint of hot water, with or without brandy, given every two hours (also continuous irrigation, *see* p. 125).

HYPODERMIC STIMULANTS.—Strychnine sulphate up to $\mathbb{M}\times$ of the liquor; ether $\mathbb{M}\text{xx}$ – xxx . These are indicated for syncope; they have the disadvantage of tending to renew the bleeding.

DIRECT STIMULATION of the heart by sinapism or fomentations.

DIET.—Hot fluid nourishment at first; light and generous diet later.

DRUGS.—Iron, with quinine or nux vomica, for anæmia.

GENERAL.—Prolonged rest, with plenty of sun and fresh air.

The Classification of Hæmorrhage.—

I. ARTERIAL: (1) PRIMARY; (2) INTERMEDIATE or REACTIONARY; (3) SECONDARY.

II. VENOUS.

III. CAPILLARY.

I. ARTERIAL HÆMORRHAGE.

OCCURS IN SPURTS synchronous with the heart's action.

Is bright red in colour.

Is much more profuse from the proximal than from the distal end of the vessel.

1. Primary Hæmorrhage.—

OCCURS at the time of the injury.

DUE TO a failure to occlude the wounded vessels.

It tends to become less and cease in time.

TREATMENT.—

ENLARGE THE WOUND AND SECURE THE BLEEDING VESSEL.—

Except :—

Wounds in the tonsillar region, when ligature of the external carotid is indicated.

Stab wounds in palm and sole, where a graduated compress can be tried first.

TIE BOTH CUT ENDS in large vessels.

LET IT ALONE if the bleeding stops naturally, except :—

The distal end of a large artery.

A punctured wound of an artery.

2. Intermediate or Reactionary Hæmorrhage.—

OCCURS within 24 hours of the injury.

DUE TO a failure of the means for the temporary arrest of hæmorrhage.

BROUGHT ABOUT BY :—

Patient's movements and restlessness, or rise of blood-pressure, and increased force of the heart, which accompanies reaction after an operation.

The dislodgement of a clot from a vessel.

The slipping of a ligature.

Failure to secure the distal end of a wounded artery, which only bleeds after anastomosing vessels have dilated.

Failure to occlude the lumen of a punctured artery. The clot is displaced from the punctured wound when blood-pressure rises.

TREATMENT.—The same as for primary hæmorrhage.

3. Secondary Hæmorrhage.—

OCCURS later than 24 hours after the injury, especially between 7 and 10 days.

DUE TO failure of repair in a wounded vessel, or ulceration of a vessel.

CAUSES.—

a. SEPTIC INFLAMMATION of the artery.

b. YIELDING OF AN ARTERIAL CICATRIX, brought about by division of its inner and middle coats by too tight ligature : disease of the artery, e.g., atheroma or calcareous change ; cachexia, hæmophilia, renal disease, diabetes ;

violent cardiac action ; increased blood-pressure ; punctured wound of artery, the lumen of the artery not being obliterated.

- c* PROXIMITY OF LIGATURE TO A LARGE BRANCH, giving a very short cicatrix.
- d*. WOUNDS OF A BRANCH just below the ligature, whose cicatrix gives way when full force of anastomotic circulation is established.
- e*. FAULTY LIGATURE, which may be : Septic—Too tight—Hard knot or sharp edge—Too quickly absorbed, e.g., catgut.

PHENOMENA OF SECONDARY HÆMORRHAGE.—Is slight at first—Recurrs at intervals—Becomes steadily greater at each recurrence—Has no tendency to spontaneous cure.

It is more frequent from the distal than proximal end of artery, because : at the distal side of a ligature there is smaller clot formed, the vasa vasorum are obliterated by ligature, the blood-pressure is higher.

TREATMENT OF SECONDARY HÆMORRHAGE.—It should always be dealt with, whether it has ceased or not, and whether it is small or large.

- a*. PRESSURE ON MAIN VESSEL above should be tried first.
- b*. OPEN THE WOUND and ligature vessel above and below bleeding point. Endeavour to render the parts aseptic, and drain.
- c*. CAUTERY used at a dull red heat, in soft, sloughy wounds.
- d*. LIGATURE OF THE MAIN TRUNK above is indicated :—
When above methods have failed.
When it is known for certain what artery is bleeding.
After amputation at shoulder or hip-joint.
- e*. AMPUTATION is called for when the bleeding occurs from the femoral artery already ligated in continuity, because a second ligature would cause gangrene. In the arm a second ligature may be attempted.
- f*. FIRM PLUGGING is the only possible treatment in deep vessels of the root of the neck, groin, and abdomen.

II. VENOUS HÆMORRHAGE.

OCCURS IN A STEADY STREAM, except—

From the cerebral sinuses it spurts synchronously with pulse.

From large veins of the neck it spurts synchronously with respiration.

Is OF A DARK COLOUR.

Is FROM THE DISTAL END of the divided vessel only, except : in the neck, in varicose veins, in branches of large veins, if no valve intervenes.

Venous Hæmorrhage, *continued*.

TREATMENT.—

PRESSURE is sufficient in superficial veins.

LIGATURE is needed for veins in the neck—Deep veins—Varicose veins.

PLUGGING is necessary when veins lie in bony cavities, e.g., cranial sinuses.

SUTURE or LIGATURE in punctured wounds of large veins so as not to occlude the lumen.

TIE THE ARTERY at a different place, but do not occlude the vein, if main vein of a limb is wounded slightly when operating to ligate the main artery in continuity.

III. CAPILLARY HÆMORRHAGE.

(including Parenchymatous Hæmorrhage).

Consists of an oozing from wound surfaces.

TREATMENT.—Sew up the wound, or, when this is impracticable, pressure, plugging, or the cauterium must be used.

HÆMOPHILIA.

DEFINITION.—An hereditary disease in which there is a tendency to spontaneous hæmorrhages and very profuse and uncontrollable bleeding from wounds.

INHERITANCE.—The disease is peculiar to the male sex, but is transmitted by females; thus the sons develop hæmophilia, and the daughters who are free from the disease often beget hæmophilic sons.

PATHOLOGY.—Of this little is known. Probably due to inadequate liberation of thrombokinase by the blood-platelets, which are abnormal qualitatively. The blood clots in the usual time after it has been shed. Blood taken from a hæmophilic patient who is not bleeding shows a lessened coagulability. Blood escaping from a wound during a serious hæmorrhage shows no difference from normal.

TRAUMATIC HÆMORRHAGES.—Except that the division of the umbilical cord is remarkably free from incident, every trivial wound is accompanied by steady and persistent oozing. Tooth extraction is often the first injury to call attention to the disease, and the steady bleeding from this may be fatal. Circumcision, or any other operation, will cause dangerous or fatal bleeding. The actual hæmorrhage is continued steadily as a capillary oozing for many days, and it is the consequent anæmia that causes death by syncope.

ECCHYMOSES.—Slight or unnoticed trauma produces extensive subcutaneous ecchymosis; hence the sufferer is often called 'a bruiser and bleeder'. The bruises slowly disappear if no external wound exists.

JOINTS.—Bleeding into the joints is common, and produces changes of synovitis and osteo-arthritis eventually (*see* Chap. XXIV).

MUCOUS HÆMORRHAGES.—The mucous membranes are not so prone to bleeding as might be anticipated. But epistaxis, hæmatemesis, or melæna occasionally occurs in a severe or fatal form.

COURSE.—In bad cases the subjects seldom survive to maturity. About sixty per cent of the affected persons die before eight years. If they survive till after puberty the prognosis is better. But only eleven per cent survive to twenty-two.

TREATMENT.—From a surgical point of view it is emphatically negative. It is most important to avoid performing operations on hæmophilic subjects, and where hæmophilic symptoms are present, to abstain from any active measures such as the cautery or aspiration of blood effusions.

Prolonged rest and firm pressure are the only methods ordinarily available.

Both stitching and the cautery are useless, because bleeding occurs from the stitch-holes or from the cauterized surface.

The following methods have had some success :—

CALCIUM SALTS.—Calcium chloride in 30–60 gr. doses, or calcium lactate 10 gr. hypodermically in a 5 per cent solution.

BLOOD SERUM.—Fresh antidiphtheritic serum is a convenient form. It is given in 20–30 c.c. doses subcutaneously or 10–20 c.c. intravenously. It has been used as a prophylactic before necessary operations.

NORMAL BLOOD applied on a dressing to the wounded surface.

GELATIN, injected subcutaneously to increase coagulability.

ADRENALIN, ERGOTININE, injected locally to contract the bleeding vessels.

OVARIAN EXTRACT, given because women are so exempt from hæmophilia.

HÆMOPLASTIN (hæmostatic serum), 2 c.c. intramuscularly.

OPEN WOUNDS OF BLOOD-VESSELS.

These are dealt with under the subject of HÆMORRHAGE, and it only remains to note—

Incised Wounds bleed very freely, because there is but little injury to cause the inner coats to curl up.

Incised wounds which do not completely sever the vessel bleed most of all, because both retraction and contraction are prevented.

Lacerated Wounds bleed less than any, or not at all, because the inner coats are curled up by the violence of the injury, and the outer sheath is also twisted up as in torsion.

Punctured Wounds—as when a bullet nicks one side of an artery—may result in a traumatic aneurysm; or, if the adjacent vein is wounded at the same time, an arteriovenous aneurysm, or aneurysmal varix, will result.

Treatment of wounded arteries and veins —

LIGATURE both ends of divided vessel, or above and below a lateral wound.

EXCEPTIONS.—Large veins should have lateral wounds carefully sutured. Large arteries may also have lateral wounds sewn together with fine silk—but this is not the usual practice. The proximal end of a divided artery may be sewn to the distal end, so preserving the lumen.

SUBCUTANEOUS INJURIES OF BLOOD-VESSELS.

Contusion and Laceration.—

CAUSES.—External blow, being run over, etc. Counter-pressure when reducing an old dislocation. Bullets of low velocity.

PREDISPOSING CONDITIONS.—Atheroma, or calcareous degeneration.

RESULTS.—

SLIGHT INJURY TO THE INNER COATS, with proliferation of the intima and thrombosis.

RUPTURE OF INNER COATS, with thrombosis, aneurysm from yielding of the outer coat, dissecting aneurysm.

INJURY WITH SUBSEQUENT SLOUGHING OF THE OUTER COAT, producing secondary hæmorrhage or aneurysm.

INJURY TO THE VESSEL MAY BECOME INFECTED, causing septic arteritis, secondary hæmorrhage, or aneurysm.

RUPTURE OF ALL THE COATS of the artery, with immediate thrombosis, or, more commonly, diffuse traumatic aneurysm.

GANGRENE may follow a contusion of an artery: from simple thrombosis, especially if the artery is calcareous; rupture of the artery; diffuse aneurysm.

SYMPTOMS OF THROMBOSIS.—Loss of pulsation in the vessels beyond the injury. Possibly a tender swelling in the position of the injured vessel.

These may appear at once after the injury, indicating rupture of the inner coats; or may be delayed for several days, indicating thrombosis from contusion and proliferation of the intima.

SYMPTOMS OF ANEURYSM.—A pulsating swelling connected with the artery appears from a few days to a few months from the time of injury. Common mode of origin of axillary and popliteal aneurysms.

SYMPTOMS OF RUPTURE, with the formation of a 'diffuse aneurysm'.—

LOCAL SIGNS.—Sudden, sharp pain at the seat of injury. Patient may be conscious of a snap. Fusiform swelling rapidly appears at injured point. Pulsation and bruit sometimes present, often not.

DISTAL SIGNS.—Cessation of pulsation in vessels beyond. Limb is cold and numb. Lividity and œdema from venous obstruction.

GENERAL SIGNS.—Weak, rapid pulse. Pallor, dyspnœa, and syncope.

TERMINATION OF RUPTURE.—

1. RECOVERY.—The swelling becomes hard by coagulation. The ruptured ends of the vessel heal in the ordinary way. Collateral circulation is established.
2. GANGRENE is produced by the pressure of the blood obliterating both the veins and collateral circulation when the main trunk is already severed.
3. EXTERNAL RUPTURE through the skin, and death from external hæmorrhage.
4. SUPPURATION of the blood mass, with subsequent bursting of the abscess, and death from secondary hæmorrhage.
5. DEATH from internal hæmorrhage. Especially if the ruptured vessel communicates with some internal cavity.

TREATMENT OF SUBCUTANEOUS INJURIES OF ARTERIES.

1. IF THE SIGNS POINT TO THROMBOSIS :—
Rest—Warmth—Aseptic preparation of the skin.
2. IF THE SIGNS POINT TO RUPTURED ARTERY :—
Put on a tourniquet above the injury if possible.
Cut down on the swelling and turn out the clots.
Tie both ends of the ruptured vessel. (It is possible to sew the proximal end of the vessel to the distal without obliterating the lumen. This is not, however, often attempted.)
3. IF THE SIGNS POINT TO SUPPURATION :—
If a tourniquet can be applied, proceed as in (2).
If a tourniquet cannot be applied, tie the artery above the injury before opening the abscess.
4. AMPUTATION is necessary if gangrene or secondary hæmorrhage occurs.

CHAPTER XIV.

DISEASES OF ARTERIES.**INFLAMMATION AND DEGENERATION OF ARTERIES.****Varieties of Arteritis.—****ACUTE ARTERITIS.—**

SIMPLE OR PLASTIC.—Producing the repair of wounded arteries.

SEPTIC.—Resulting from septic injuries and wounds.

EMBOLIC.—Resulting from the lodging of an infective embolus in the lumen of an artery.

CHRONIC ARTERITIS.—

ENDARTERITIS DEFORMANS.—Atheroma. Chronic inflammation of the inner coats, of patchy distribution, affecting large vessels and resulting in dilatation.

ENDARTERITIS OBLITERANS—IDIOPATHIC, SYPHILITIC, TUBERCULOUS, OR DIABETIC.—Uniform inflammatory proliferation affecting the whole circumference of small vessels and resulting in occlusion.

Simple, Plastic, or Traumatic Arteritis.—

PRODUCED by aseptic contusions and wounds.

RESULTS in proliferation of the tunica intima—Exudation from the vasa vasorum—Thrombosis of the vessel and conversion into a fibrous cord.

Is to be regarded as a conservative act of repair rather than disease.

Septic Arteritis.—

CAUSES.—A septic wound—A septic ligature—The extension of an abscess—Very virulent ulceration, e.g., phagedæna. (Infection from the blood-stream is considered under the next head.)

PATHOLOGY.—The coats of the artery become acutely inflamed. They are softened and disintegrated by the peptonizing action of bacteria and their toxins.

The leucocytes and fibroblasts of the exudation are killed by the toxins, and form pus.

The blood-clot in the vessel is either disintegrated by the same agents, or washed out by the blood-stream.

RESULTS.—Secondary hæmorrhage (*see* p. 128). Hæmorrhage from phthisical cavities, from chronic ulcers, or from malignant growths, is generally the result of this process.

TREATMENT.—That for secondary hæmorrhage. etc.

Embolic Arteritis.—Generally in young people. An infective embolus is dislodged from the aortic valves in malignant endocarditis or acute rheumatism. It blocks a small artery.

RESULTS.—(1) Abscess, as in pyæmia; (2) Idiopathic aneurysm—an acute softening of the arterial wall yields to the blood-pressure, and so gives rise to an aneurysm.

Atheroma.—

CONSISTS IN a chronic endarteritis, which results from long-continued strain, and produces degeneration of the arterial wall.

CAUSES.—Old age—Mechanical strain of laborious occupations—Syphilis—Chronically raised blood-pressure: e.g., renal disease, gout, lead poisoning, alcoholism.

MORBID ANATOMY, Etc.—

DISTRIBUTION: Aorta—Large arteries—Coronary arteries—Arteries at the base of the brain—Splenic artery—Arteries of the leg more frequently than the arm—The curved arteries and the convex side of the curved portions are first affected—Points where large arteries bifurcate—Points where branches are given off from large vessels—Points where arteries curve round bones, e.g., the subclavian over the first rib—Points where arteries are subject to constant flexion, e.g., the popliteal.

NAKED-EYE APPEARANCE—

VESSEL IS DILATED AND HYPERTROPHIED. In some cases elongated and tortuous.

INTERIOR PRESENTS: Opaque oval white patches under the endothelium—Calcareous plaques bared of endothelium—Softened white swellings, the atheromatous abscesses—Shallow excavations into the tunica media, atheromatous ulcers.

MICROSCOPICAL CHANGES.—

Proliferation of the cells of the deep layer of the tunica intima. This tissue is avascular, and soon degenerates: Fatty degeneration, or calcareous degeneration forming 'laminar calcification' of the artery.

The tunica media is invaded to some extent.

The endothelial lining, cut off from the vasa vasorum, is lost.

The tunica adventitia is thickened.

RESULTS OF ATHEROMA.—

1. **ANEURYSM**—from yielding of the weakened wall.
2. **DISSECTING ANEURYSM**—by a forcing of the blood between layers of an artery at the edges of an 'atheromatous ulcer'.
3. **THROMBOSIS**—possibly gangrene.
4. **RUPTURE** from slight violence.
5. **EMBOLIC OBLITERATION** of the vessel by a detachment of a calcareous plate.
6. **DEGENERATION OF STRUCTURES SUPPLIED**, e.g., in the case of the heart (fibroid or fatty) or the brain (white softening).

TREATMENT.—Light diet, with little meat and no alcohol. Gentle exercise. Keep the blood-pressure low by aperients or nitrites.

Syphilitic Endarteritis.—Occurs in the tertiary stage of the disease. Attacks small arteries. Brain, kidneys, and the region of gummata are most commonly affected.

CONSISTS IN: Proliferation of cells of tunica intima. The new layer of cells is vascularized from the vasa vasorum. Slight thickening of tunica media. Some thickening of adventitia.

RESULTS IN: Obliteration of the lumen of the vessel. Degeneration of the tissues supplied into gummatous material, or, in the brain, white softening with consequent paralysis.

TREATMENT.—Iodide of potassium.

Endarteritis Obliterans.—Produces changes similar to the last described. There is no evidence of syphilis. Coldness, numbness, and gangrene of the parts supplied. Great pain.

Tuberculous Endarteritis.—Always occurs in the area invaded by tubercle. The small vessels are obliterated by a proliferation of the intima. Hence tuberculous areas undergo caseous degeneration. (The ulceration which opens large vessels and causes serious hæmorrhage is always produced by secondary sepsis, e.g., in the lung or intestine.)

Diabetic Endarteritis.—Similar to the above obliterating forms of endarteritis. Affects the anterior and posterior tibial arteries most commonly. Produces one form of diabetic gangrene.

Degeneration of Arteries.—

FATTY DEGENERATION.—Affects the intima—Occurs in the aorta—Is difficult to distinguish from atheroma.

CALCAREOUS DEGENERATION.—Occurs in old people—Affects the tunica media—Muscle fibres are transformed into rings of calcified material—Occurs in medium-sized arteries, e.g., brachial.

PRODUCES: Loss of arterial tone—Deficient circulation in the parts supplied—Coldness and numbness—Cramps, pain, and tingling—Thrombosis—Senile gangrene (the branches are calcified, and are therefore unable to dilate so as to form efficient collateral circulation)—Rupture from slight violence—Secondary hæmorrhage after operations.

ANEURYSM.

Definition.—A blood-tumour communicating with an artery.

Classification.—

- I. IDIOPATHIC, or spontaneous.—(1) FUSIFORM; (2) SACCULATED; (3) DISSECTING.
- II. TRAUMATIC.—(1) CIRCUMSCRIBED; (2) DIFFUSE, or ruptured artery.
- III. ARTERIOVENOUS.—(1) ANEURYSMAL VARIX; (2) VARICOSE ANEURYSM.
- IV. ANGIOMATA.—(1) CIRROID ANEURYSM, or ANEURYSM BY ANASTOMOSIS.

I. IDIOPATHIC ANEURYSM.

CAUSES.—

- a. WEAKENING OF THE ARTERIAL WALL.—Atheroma—Syphilis (?)
—Embolic arteritis—Partial laceration, or the cicatrix of an old injury.
- b. INCREASE OF THE BLOOD-PRESSURE.—Violent exercise, especially when intermittent—Cardiac hypertrophy—Plethora—Chronic renal disease—Gout and lead poisoning.
- c. INDIRECT CAUSES, which bring about (a) or (b), or both.—
Age.—That of maximum activity—30–50. Aneurysms due to infective emboli are the only ones which occur more commonly in children.
Sex.—Males are ten times more liable than females, except in carotid aneurysm and dissecting aneurysm, which are commoner in women.
Occupation.—Soldiers, sailors, athletes, etc.
Nationality.—Anglo-Saxons.
Strain.—Right arm is more prone than the left. Vessels which are liable to flexion and extension, e.g., the popliteal, are very liable to aneurysm.
Alcoholism.
Symmetry, as seen, e.g., in double popliteal aneurysm, is caused by identical conditions on the two sides.

1. Fusiform Aneurysm.

PATHOLOGY.—The weakened arterial wall yields in every direction to the blood-pressure (*Fig. 27, B*).

The vessel is thus elongated and dilated in its entire circumference.

All three coats of the vessel form the aneurysm.

The wall of the aneurysm is thicker than that of the normal artery.

The inner coat is generally thickened by atheroma.

The middle coat is thinned.

The outer coat is thickened by fibrous tissue.

Contains little or no clot.

DISTRIBUTION.—Aorta (common)—Largest arteries (rare).

COURSE.—Of slow development and progress. Comparatively symptomless. It may fill with clot, and be thus cured.

COMPLICATIONS.—One portion of the sac wall gives way, and a sacculated aneurysm is produced.

TREATMENT.—Only constitutional.

2. Sacculated Aneurysm.

PATHOLOGY.—One point in the arterial wall is weaker than the rest. This may be a thin patch of atheroma, or a scar, or an 'atheromatous ulcer'. A local bulging takes place at this spot. The inner and middle coats disappear in this situation (*Fig. 27, C*).

THE OUTER COAT (added to by fibrous tissue) forms the only layer of the sac.

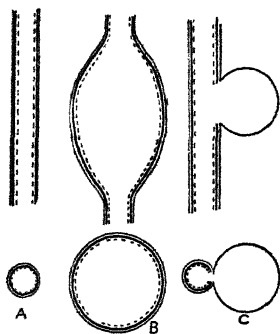


Fig. 27.—The essential changes of a fusiform and saccular aneurysm. Upper figures show vessel in longitudinal, lower in transverse section. A, Normal artery, showing three coats; B, Fusiform aneurysm, all the coats being equally stretched; C, Saccular aneurysm, in which the inner and middle coats have given way, the sac consisting of the outer coat only.

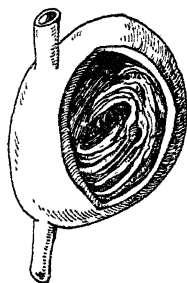


Fig. 28.—Saccular aneurysm, partly filled by laminated fibrin.

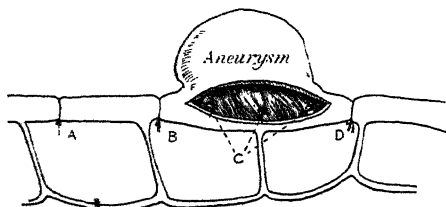


Fig. 29.—Diagram illustrating various ligations which may be used in the treatment of an aneurysm. A, Distant proximal ligation—Hunter's operation; B, Proximate proximal ligation, with no branch between ligation and sac; C, Internal orifices of vessel and branches sewn up in Matas' operation; D, Distal ligation.

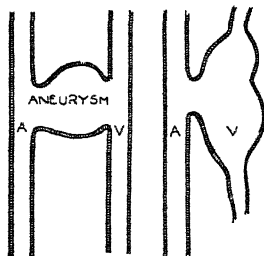


Fig. 30.—The left-hand figure shows diagrammatically an arteriovenous aneurysm or varicose aneurysm, i.e., an aneurysmal dilatation of an artery which communicates with a vein. The right-hand figure shows an aneurysmal varix, i.e., an artery opening directly into a vein which becomes dilated owing to the arterial pressure. A, Artery; V, Vein.

THE ABSENCE OF THE INNER AND MIDDLE COATS is of the utmost importance.

They form three-quarters to seven-eighths of the thickness of a normal artery.

They contain most of the elastic and muscular tissue to which the vessel owes its resiliency.

They contain the vasa vasorum, to which the vessel owes its nourishment.

THE SAC IS STRENGTHENED—

From the outside, by the addition of fibrous tissue and by the incorporation of surrounding structures.

From the inside, by the deposition of laminated clot.

CONTENTS.—

a. White, laminated, fibrinous clots at periphery (*Fig. 28*). Generally in the parts least exposed to the blood-stream.

This is seldom organized into fibrous tissue, because of constant movement of pulsation, and absence of the tunica intima with vasa vasorum.

b. Red blood-clot of recent origin may be present, always is when the aneurysm has lately been cured.

c. Fluid blood communicating with blood-stream.

RELATION OF THE CONTENTS TO THE SAC WALL.—The presence of laminated clot strengthens the sac. The presence of any clot lessens the fluid contents.

The pressure on the sac wall of an aneurysm depends on the area of fluid blood it contains, and varies as the square of the diameter of the fluid-containing cavity. It is thus a 'living Bramah press'.

Effects of an Aneurysm.—

1. ON SURROUNDING STRUCTURES.—

EXCITES INFLAMMATORY REACTION.—Usually plastic. When infected it may be suppurative.

VEINS.—Compression, with cyanosis and oedema. Rarely a communicating perforation is formed.

NERVES are flattened out and destroyed. Great pain—rarely numbness and anæsthesia. Motor paralysis (rare, except in the case of the recurrent laryngeal).

BONES.—Absorbed and eroded: notably vertebræ and sternum.

CARTILAGES are much more resistant than bones.

TENDONS AND FASCIÆ are incorporated in the sac.

MUCOUS CANALS are compressed and displaced.

2. ON THE CIRCULATION.—

LOSS OF FORCE, i.e., by blood-pressure beyond the aneurysm. Partly compensated by cardiac hypertrophy and dilatation of anastomotic channels.

THE PULSE.—Is delayed. Is smaller and weaker. The impulse and dicrotic waves are absent.

AN ARTERY MAY BE BLOCKED by the cure of the aneurysm; by the pressure of the aneurysm on the vessel; by the involvement of a branch of the main vessel in the sac.

Aneurysm, continued.

Course and Terminations.—(1) CURE; (2) GROWTH AND RUPTURE; (3) SUPPURATION AND RUPTURE (or cure—very rare).

CURE OF AN ANEURYSM occurs in three stages:—

1. FILLING OF THE SAC with blood-clot.
2. OBLITERATION OF THE LUMEN of the vessel between the aneurysm and the nearest collaterals. This is the essential condition of cure without which the final stage cannot occur.
3. ORGANIZATION OF THE BLOOD-CLOT into fibrous tissue.

SPONTANEOUS CURE may be caused by:—

Extension of the blood-clot from the aneurysm into the artery.
Pressure of the aneurysm upon the artery so as to obliterate it.
Displacement of laminar clot from the aneurysm into the artery as an embolus.

Arteritis excited by mere irritation (plastic), or suppurative by infection. Both of these are very rare.

RUPTURE OF AN ANEURYSM is much the commonest natural termination.—

THROUGH THE SKIN OR MUCOUS MEMBRANE.—

By small ulcer at first.

Bleeding like that of secondary hæmorrhage.

Externally, œsophagus, trachea, bronchus, stomach, or intestine.

THROUGH SEROUS OR SYNOVIAL MEMBRANE.—

By slit-like rupture.

Immediate large, generally fatal, hæmorrhage.

Pleura, pericardium, knee-joint.

SUBCUTANEOUS RUPTURE.—

Blood may extend without definite limit, producing gangrene as in a ruptured artery. Blood may be circumscribed for a time: the so-called 'leaking aneurysm'.

SUPPURATION OF AN ANEURYSM.—Caused by infection of the tissues in and round the aneurysm.

Their resistance may have been weakened by prolonged or rough pressure or manipulation, or sudden coagulation in a large sac.

Especially common in axillary aneurysm.

Sac wall sloughs.

Artery above and below bleeds furiously when abscess opens.

Rarely the artery above and below is sealed by plastic arteritis, and the aneurysm is thus cured.

Signs of a Sacculated Aneurysm.—

TUMOUR.—Placed over and fixed to an artery. Pulsates synchronously with the heart.

Pulsation is expansile; ceases when artery above is compressed.

A BRUIT is heard over the swelling, and sometimes a thrill is felt.

Systolic in time, blowing in character. Increased by pressure of the stethoscope. Rarely it is diastolic as well as systolic, especially in aortic aneurysms.

PULSE BEYOND is delayed in time and lessened in force.

PRESSURE SIGNS.—Congestion of veins with œdema. Paralysis of nerves. Muscular wasting.

PAIN.—Constant severe boring, especially when bones are eroded. Occasional lancinating pains in area of distribution of sensory nerves.

Diagnosis.—

ABNORMAL PULSATING VESSELS, e.g., 'Pulsating Aorta'.
In this there is no tumour.

TUMOUR OVER AN ARTERY.—In this the pulsation is heaving but not expansile; the pulsation ceases if the tumour is lifted off the artery; pressure on the artery does not affect the size of the tumour.

A bruit is sometimes heard, but is rasping and only occurs along the line of the vessel.

CYSTS OVER ARTERIES, which may communicate with joints. Pulsation may be present and may be expansile. But pressure on the artery above does not lessen the size of the tumour.

If the cyst can be emptied into the joint, it fills out gradually and not by jerks.

PULSATING VASCULAR TUMOURS, e.g., Goitre and Sarcoma. Tumour cannot be much reduced either by pressure or by compressing the artery.

Bruit is whiffing, and very variable in different parts.

The tumour can often be moved away from or along the main artery (e.g., goitre).

The tumour is often in a situation where no large artery exists (e.g., the front of the head of the tibia).

Modification of the Signs of an Aneurysm.—

ANEURYSM UNDERGOING CURE.—The sac is partly filled with clot. The pulsation loses its expansile character. Pulsation ceases when the lumen of the artery is obliterated.

LEAKING OF RUPTURED ANEURYSM.—Rapid increase in size. Outline is indefinite. Pulsation and bruit are lessened or disappear. Pain and collapse. Congestion, œdema, and numbness of parts below.

SUPPURATING ANEURYSM.—Increase in swelling, with indefinite outline. Pulsation and bruit lessened. Signs of acute inflammation. Œdema over tumour.

Treatment of Aneurysm.—

CONSTITUTIONAL.—

Absolute rest, mental and physical.

Starvation, especially as regards liquids: Bread 6 oz., meat 2 oz., milk 6 oz. daily.

Large doses of potassium iodide to reduce blood-pressure.

Treatment of Aneurysm, *continued*.

LOCAL.—

1. COMPRESSION of the artery above the aneurysm.—
 Digitally. By relays of assistants acting 20 min. at a time.
 The thumb is reinforced by a 6-lb. weight.
 Instruments, e.g., the various tourniquets.
 Results of compression: Often nothing, or
 Aneurysm may be gradually cured by deposition of
 laminated clot.
 Aneurysm may be suddenly cured by clotting of all
 the blood in the aneurysm and vessel at once.
 The condition often recurs from a dissolution of
 the clot before organization has taken place.
 Disadvantages of compression: Very painful, requiring
 anæsthetic or opiates. Digital requires so many
 assistants. Instrumental often causes sloughing of the
 skin. Is very tedious and uncertain. It causes enlarge-
 ment of collaterals, and therefore subsequent cure by
 distant proximal ligature is rendered uncertain.
2. FLEXION OF ELBOW OR KNEE.—Only applicable to
 aneurysm at the elbow or ham when these are of small size.
3. ESMARCH'S BANDAGE.—Applied for 1½ hours under an
 anæsthetic. Followed by slight compression of the artery
 above for some days.
 Is very uncertain. It may rupture the sac or cause
 thrombosis of the collaterals, with consequent gangrene.
 (Methods (1), (2), and (3) are practically obsolete.)
4. LIGATURE OF THE MAIN ARTERY.—The routine method.
 - a. Proximal (*Fig. 29*): Close to the sac (Anel's operation);
 at a distance from the sac (Hunter's operation).
 - b. Distal: Used when proximal side of artery is out of
 reach. Main vessel (Brasdor's) (*Fig. 29*); main branches
 of the vessel (Wardrop's).
 The above places of ligature are placed in the order of
 efficiency (*see below*).
5. EXCISION OF ANEURYSM.—Preliminary tourniquet. All
 vessels connected with the sac are ligatured and cut. Sac is
 carefully dissected out.
6. INCISION OF ANEURYSM (Matas' modification of the
 'old operation').—Preliminary tourniquet. Sac is freely
 opened and emptied of blood and clot. The mouths of all
 vessels opening into the sac are sewn up by separate silk
 sutures (*Fig. 29*). The redundant portions of the sac are
 removed. The rest of the sac is folded over and sewn together
 as a solid pad under the skin.
 The use of stitches from the inner side is the distinctive
 feature of this operation.
 Advantages over excision are, no risk of injury to veins,
 nerves, and collaterals which lie so close to the sac.

The only method available when the proximal ligature has failed.

In addition to this, which is the obliterative method of Matas, there are two others, the conservative and the reconstructive. The conservative method is for cases of sacculated aneurysm with narrow mouth communicating with the artery. After opening the sac, the mouth of communication is sewn together. The reconstructive method is for a fusiform or a sacculated aneurysm with large mouth. The lumen of the artery is reconstructed by sewing together the redundant walls of the sac over a channel leading from the afferent to the efferent artery. The value of both these methods is doubtful, whilst that of the obliterative method is certain.

7. THE INTRODUCTION OF FOREIGN BODIES INTO THE SAC.—Only used in inoperable situations, as in the aorta, and in the case of the abdominal aorta it has given recent successes: (a) Simple needles; (b) Needles connected with the positive poles of a battery; (c) Piano wire: many feet passed into the sac and left. May be passed at random through a cannula. Best passed by a special (Colt's) mechanism, as a complete spherical wire network.
8. THE SUBCUTANEOUS INJECTION OF GELATIN.—10–20 oz. of a sterilized solution of gelatin is injected into the subcutaneous tissue. Only used in internal aneurysm.
9. AMPUTATION.—Ruptured or inflamed aneurysms (in certain cases). When gangrene or secondary hæmorrhage has resulted from ligature. Subclavian aneurysm (rare).

ON THE CHOICE OF THE METHOD OF TREATMENT.—

MATAS' OPERATION is the ideal treatment, and the only one when ligature has failed.

PROXIMAL LIGATURE CLOSE TO THE SAC is simple and efficient, but sometimes difficult because of the altered anatomical relations.

PROXIMAL LIGATURE AT A DISTANCE FROM THE SAC is easy, but liable to failure if the collateral circulation is too free, or to gangrene if it is not free enough.

COMPRESSION is to be used: In very nervous people who dread an operation; in patients with severe heart disease; in patients with extensive disease of the vessels.

The other methods are only suitable for special cases.

On the Ligature of an Artery in Continuity.—

LIGATURE MATERIALS.—

SILK.—Can be sterilized by boiling, but is unabsorbable, and therefore, if it become septic, may cause a sinus. It is the most generally used ligature.

CATGUT.—Requires complicated sterilization, and it is too quickly absorbed to be trusted for large arteries.

KANGAROO TENDON AND OX AORTA.—Are absorbed more slowly than catgut.

Ligature of an Artery in Continuity, *continued*.

METHOD OF TYING.—

STAY KNOT should be used by taking two strands of ligature, tying the first turn of a knot in each separately, and then knotting the two pairs of ends together.

TIGHTLY ENOUGH to occlude the lumen without rupturing the inner coats of the vessel.

Ligature should be passed inside the sheath of the vessel. The vessel should be disturbed from its bed as little as possible.

LIGATURE OF MAIN VEIN.—The main vein should also be tied, because its ligature will cause a local rise in blood-pressure which helps to open up anastomotic blood channels.

CHANGES PRODUCED IN THE ARTERY.—The lumen is occluded. The inner and middle coats are ruptured and curl up inside the vessel if the ligature is drawn too tight. Clot forms between the ligature and nearest branches above and below. Clot on the distal side of ligature is smaller and slower in formation than on the proximal. A portion of the occluded vessel is converted by the organization of the blood-clot into a fibrous cord.

ADVANTAGES OF APPLYING THE LIGATURE WITH MODERATE FORCE.—Inner and middle coats are not ruptured. Less liability to secondary hæmorrhage, especially when the vessel is diseased or when the ligature is very near a large branch. Vessel walls are much thinner when distended by blood than after death. Outer coat is very thin, only $\frac{1}{8}$ to $\frac{1}{4}$ of the whole thickness.

LIGATURE FAILS TO OCCLUDE when : (1) Knot has slipped—In single-strand ligatures the beat of the artery opens the first turn of the knot whilst second is being tied. (2) Ligature is absorbed before organization of the clot has occurred.

EFFECTS ON THE CIRCULATION.—The heart is embarrassed when a large artery is ligatured. Parts below the ligature become cold and pulseless; then the anastomotic channels dilate. Pulsation below the ligature is gradually resumed. Tissues become hyperæmic before they are natural. Some of the anastomotic channels permanently hypertrophy.

TREATMENT AFTER LIGATURE.—Parts should be kept warm and at rest in a horizontal position. Any tight bandaging should be avoided.

GANGRENE MAY OCCUR AFTER LIGATURE.—

CAUSES.—(1) Circulation being too weak to open up anastomotic channels, either from a weak heart or as the result of a large hæmorrhage. (2) Diseased vessels unable to dilate for anastomosis. (3) Vessels contained in bony canals, e.g., internal carotid and vertebral, cannot dilate. (4) Pressure of a tight bandage on anastomosing circulation. (5) Thrombosis extending down the vessels. (6) Cold or inflammation occurring directly after ligature.

EXTENDS.—Generally as dry gangrene of only one or two toes, or dry gangrene up to the ligature; or sometimes as moist gangrene up to the ligature.

TIME.—Occurs third to tenth day after ligature.

TREATMENT.—Limited dry gangrene: wait to see the extent of natural repair. Extensive gangrene—dry or moist: amputate.

PROXIMAL LIGATURE CLOSE TO THE SAC (Anel's operation) causes obliteration of the artery and extension of the clot from the ligature to the sac.

It is most efficient because no branch intervenes between the ligature and the sac. It only causes one block in the circulation, and therefore only one set of anastomosing vessels is required. It is difficult to perform, because the aneurysm so distorts the anatomical relations.

PROXIMAL LIGATURE AT A DISTANCE FROM THE SAC (Hunter's operation) is easy to perform. The artery is more likely to be healthy.

Causes a double block in the circulation: (1) At the ligature extending to the next branch; (2) Blood clots in the sac and extends to the vessel from which it springs.

Circulation has to be carried from the artery above the ligature by anastomotic channels to the artery between the ligature and the aneurysm. Thence by a second set of anastomosing vessels to the artery below the aneurysm. Hence two sets of anastomoses are required, and gangrene may arise by a failure of this double set.

Failure to cure occurs in Hunter's operation from too great freedom of anastomosing channels (this is often the case after long compression); the blood does not clot in the sac.

SIGNS AFTER HUNTER'S OPERATION when successful.—Shrinking and loss of pulsation in sac. Return of slight pulsation when the first anastomosing channels have dilated. Gradual consolidation of the sac as the second anastomosis is established.

3. Dissecting Aneurysm.

ETIOLOGY.—A rare disease, commoner in women than men.

ANATOMY.—Begins in the aorta and spreads down to the iliac arteries and up the carotids. The blood is forced between the coats of the vessels, separating the inner and middle from the outer. It probably begins as an atheromatous ulcer. The folded inner coats block the lumen of the vessels.

SYMPTOMS.—Sudden, severe pain in the back and trunk, with coldness and pain in the legs from cessation of the circulation.

TREATMENT is impossible, and a fatal result occurs in a few days.

II. TRAUMATIC ANEURYSM.

CAUSES.—(1) Contusion or subcutaneous rupture; (2) A small punctured or valvular wound of an artery; (3) The yielding of a cicatrix of a partially divided artery; (4) Closure of the external wound over a wounded artery.

DEGREES.—(1) Circumscribed; (2) Diffuse.

Circumscribed Traumatic Aneurysm.—The aneurysm is limited by a distinct sac. It is usually formed by the yielding of a cicatrix, or by the relaxation of pressure over a vessel some time after the injury. Its course is that of a spontaneous aneurysm.

OCCURS most commonly in the hand, foot, or scalp.

TREATMENT.—Pressure, excision, or ligature.

Diffuse Traumatic Aneurysm.—Occurs soon after the injury, and the blood collection is widely diffused in the fascial planes without a limiting sac.

SIGNS.—A rapidly growing swelling in the line of an artery. Pulsation and bruit are ill-marked. The skin is discoloured and tightly stretched. The pulse is weak or lost below. Pain is intense.

RESULTS.—(1) External bursting; (2) Gangrene; (3) Suppuration.

DIAGNOSIS has to be made from abscess or cellulitis by the thrill and bruit and great interference with the circulation. Also by its rapid development.

OCCURS most commonly in the axilla, groin, and ham.

TREATMENT.—Incision and ligature above and below the wound.

III. ARTERIOVENOUS ANEURYSM.

Definition.—An abnormal communication between any artery and vein (*Fig. 30*).

VARIETIES.—(1) Aneurysmal varix; (2) Varicose aneurysm.

Aneurysmal Varix.—A dilated varicose vein communicating directly with an artery.

CAUSES.—Stabs, phlebotomy, or gunshot wounds, which simultaneously wound a vein and artery. Very rarely idiopathic or congenital. Most common at the elbow.

STRUCTURE.—The artery is enlarged and thickened, the vein is tortuous, and its branches varicose, with a large sac opposite the communication with the artery.

SYMPTOMS AND SIGNS.—A fluid compressible swelling associated with varicose veins. Marked pulsation and a loud bruit are evident in the swelling, which partly empties on raising limb.

Pain may be severe, and congestive signs occur in skin below.

TREATMENT.—Pressure or ligature of the artery, or suture of the opening in the arterial wall.

Varicose Aneurysm.—An aneurysm which communicates with a vein as well as with an artery.

CAUSES.—As above, and also by the pressure of an ordinary aneurysm opening into a vein.

SIGNS are the same as in the last, except that a more solid aneurysmal tumour may be detected in addition to the pulsating varicose veins.

TREATMENT.—Excision, with ligature of artery and vein.

(Class IV is considered with other angiomas on p. 152.)

CHAPTER XV.

DISEASES OF VEINS AND LYMPHATICS.**VENOUS THROMBOSIS.**

Definition.—A coagulation of the blood in the veins.

Causes.—

INJURIES OF THE VEIN WALLS.—Contusion, laceration, compression, ligature.

INFLAMMATION OF THE VEIN.—Phlebitis. All septic processes are apt to cause phlebitis and then thrombosis in neighbouring veins, e.g., appendicitis often causes femoral thrombosis.

DEGENERATION OF THE VEIN.—Varicose veins. The dilated cavities, rough coat, and sluggish stream frequently produce thrombosis.

BLOOD CHANGES. DIMINISHED RATE OF FLOW.

Varieties of Thrombi.—

RED THROMBI are formed by clotting *en masse*, so that the red cells are included.

WHITE THROMBI consist of fibrin slowly formed from which the red cells are absent.

INFECTIVE THROMBI contain living micro-organisms.

Effects of Thrombosis on the Vein.—

1. The clot may become organized into connective tissue and the channel permanently occluded.
2. The clot after becoming fibrous is calcified and forms a phlebolith.
3. The lumen of the vein may be re-established by gradual opening up of the interstices of the clot.
4. The clot may disintegrate before it has firmly formed. If septic this produces pyæmia.
5. The clot may be washed out *en masse* and form an embolus.

Effects on the Parts below the Thrombus.—

Great swelling and solid cedema (*see* PHLEBITIS).

Enlargement of collateral veins.

EMBOLISM.

Definition.—A blocking of the blood-vessels by a substance carried thither by the blood-stream.

Regarded as to its effects, it is generally a disease of the arteries, but in its origin it is usually a disease of the veins.

Embolism, *continued*.

Varieties of Emboli.—

SIMPLE.—

FROM THE HEART.—Vegetations from valves, or clots formed in dilated cavities.

FROM THE ARTERIES.—Atheromatous plates, clots from an aneurysm.

FROM THE VEINS.—Thrombi.

AIR.—Introduced through a wound of a large vein, generally in the neck during inspiration. If large in amount it produces a frothy blood condition which clogs the heart and causes death.

FAT.—A very rare condition after bone injuries; the minute vessels of the brain and lungs are chiefly affected.

INFECTIVE.—Consist in infected portions of blood-clot and zooglœa masses of bacteria. Produce infarctions and pyæmic abscesses.

MALIGNANT.—Formed by the growth of soft, friable, malignant tissue, generally sarcoma, into the cavity of veins. Particles are washed away and cause metastatic growths, usually in lung.

PARASITIC.—Ova and scolices of *tænia*, *filaria*, etc.

Pathological Results of Embolism.—These depend upon:

(1) The size and position of the vessel blocked; (2) The infective or simple character of the embolus; (3) The relation of the blocked vessel to collateral circulation.

IN SIMPLE EMBOLI affecting terminal arteries:—

ANÆMIA.

NECROSIS (e.g., white softening of the brain).

INFARCTION: a cone of tissue whose vessels are all thrombosed, the embolus being at the apex. The infarct subsequently organizes into fibrous tissue and cicatrizes.

HÆMORRHAGIC INFARCTION occurs in very vascular organs, e.g., the lung, kidney, and spleen, and consists in a venous engorgement of the infarcted area.

IN INFECTIVE EMBOLI, infarction is followed by local suppuration forming *pyæmic abscesses*.

When the infected embolus lodges in an artery, an acute or inflammatory *aneurysm* may follow.

IN THE MAIN VESSELS OF THE LIMBS, gangrene may occur under conditions mentioned (*see GANGRENE*).

Special Clinical Forms of Embolism.—

CARDIAC AND PULMONARY EMBOLISM.—A large clot becomes entangled in the right side of the heart or the pulmonary artery. Sudden death, accompanied by great pain over the heart, results.

IN THE BRAIN.—Generally the middle cerebral, supplying the motor cortex and motor tracts. Produces white or yellow softening and hemiplegia.

IN THE RETINA.—Permanent blindness.

IN THE LUNG.—Sudden pain, dyspnoea, and hæmoptysis. Very rarely some local signs of pleurisy and consolidation. Simple infarcts cicatrize, infective ones form abscesses.

IN THE LIVER.—Usually infective, from the portal area, e.g., an appendicitis. Results in multiple abscesses.

IN THE SPLEEN OR KIDNEY.—Sudden pain in the affected organ, with occasional hæmaturia in the latter.

IN THE INTESTINE.—A large vessel is usually blocked. Tympanites, obstruction, and gangrene usually result.

Embolectomy.—Removal of an embolus from an artery. Has been successfully performed in main vessels of limbs and has been attempted in pulmonary vessels. For success embolus must be removed within a few hours.

METHOD.—Site of embolus is located, vessel exposed and lightly clamped on proximal side. Vessel is incised longitudinally and embolus removed. This is facilitated by releasing clamp, when arterial pressure will wash artery free. Clamp is again lightly applied, and vessel repaired with paraffined silk.

PHLEBITIS.

Definition.—Inflammation of the vein wall.

Causes.—

SIMPLE.—Injury, pressure, gout, varicosity. Idiopathic cases are not uncommon.

INFLAMMATORY.—Thrombosis, spreading from a septic focus. Inflammatory lesions outside the vein. Septic wounds.

Pathology.—In simple cases a plastic organizing thrombosis occurs. In septic cases varying degrees of acute inflammation attack (1) the inner coats, (2) the whole vein, (3) the tissues outside the vein. In the latter case an abscess is formed. Thrombosis usually spreads some distance up and down the vein.

Symptoms.—A hard, painful, cord-like swelling forms over the vein. Skin over this is dusky, congested, and oedematous. If the vein is superficial there are no other signs.

If it is the main deep vein of the limb, **MASSIVE SOLID ŒDEMA** occurs, with considerable lymphatic engorgement (white leg).

SUPERFICIAL VEINS ENLARGE in order to carry on the collateral circulation.

FEVER, with rigors, occurs, and is proportioned to the infectivity of the process.

ABSCESSES DEVELOP round an infective phlebitis.

Phlebitis, *continued*.

Complications and Sequelæ.—

Cardiac or pulmonary embolism follows the dislodgement of a thrombus.

Pyæmia results from disintegration of a septic thrombus.

Permanent cedema, with varicose veins, is left in the leg when the deep femoral is blocked.

Treatment.—

Rest and elevation in bed for 6 weeks.

Belladonna application for pain.

Excision of the veins in recurrent superficial phlebitis.

Incision, removal of clot, and proximal ligature in infective phlebitis, e.g., in the jugular vein following acute mastoiditis.

VARICOSE VEINS.

Definition.—A redundancy, tortuosity, lengthening, and thickening of a group of veins.

Distribution.—

Saphena veins of the legs, veins of the rectum (hæmorrhoids), and of the testes (varicocele).

Causes.—

Congenital over-development of the veins.

Absence or incompetence of the valves at the mouth of the saphenous veins.

Continuous over-distention caused by standing.

Increased abdominal pressure, from pregnancy, corpulency, or tumour.

Anatomy.—

THE INTERNAL SAPHEOUS VEIN is generally affected; the external more rarely.

The veins are dilated, thickened, lengthened, tortuous, and destitute of valves. A condition like atheroma frequently develops in their walls.

Localized pouches occur, or may constitute the main disease.

The tunica media is atrophied, the adventitia much thickened.

In extreme instances the vessel gapes when cut across.

Signs.—

The veins themselves form tortuous dilatations under the skin, chiefly on the inner side of the leg below the knee.

Congestion, cedema, eczema, and ulceration result from the impeded circulation in neglected cases. This is most marked above the ankle and in front of the tibia.

Pain, tiredness, and aching are usual symptoms.

Complications.—

RUPTURE occurs from an injury of a thin pouch, or by ulceration. Bleeding may be severe.

PHLEBITIS is common and aggravates the congestive signs.

Phleboliths may form in some of the veins.

EMBOLISM is comparatively rare.

Treatment.—

PALLIATIVE.—Superficial support by means of elastic bandages or stockings, adjusted before the patient gets up.

Exercise, as distinguished from standing, is beneficial, as promoting the deep muscular circulation.

Unna's paste is useful for all congestive and inflammatory conditions.

Congestive ulcers to be treated as already described (*see* p. 14).

RADICAL OR OPERATIVE.—This is required (1) In candidates for military, police, and other public posts; (2) When congestive complications are present; and (3) When great pain and aching exist.

It is contra-indicated: (1) When the condition is secondary to deep thrombosis, coming on after, e.g., 'white leg'; (2) When it is only marked during pregnancy; (3) When it is diffuse, painless, and well relieved by elastic bandages.

OPERATIONS.—

TRENDELENBURG'S.—Consists in tying the saphenous vein just below the saphenous opening. It is indicated: (1) When a marked impulse occurs in the veins on coughing, showing a valvular incompetence; (2) When pressure over the top of the vein prevents the varicose veins from re-filling after they have been emptied; (3) When only the tributaries of the internal saphenous vein are involved.

MULTIPLE EXCISION OR LIGATURE over all prominent veins is the most certain cure.

A judicious combination of the two methods gives the best results.

INJECTION OF SCLEROSING FLUIDS.—Injection of certain solutions into the vein lumen causes active thrombosis with formation of an adherent clot and final obliteration of the vein.

SOLUTIONS USED.—The three solutions in common use are: sodium morrhuate, 10 per cent; sodium salicylate, 30 per cent; quinine-urethane (quinine hydrochloride 4 grm., urethane 2 grm., water 30 c.c.).

METHOD.—Skin is sterilized. Needle on syringe is inserted into vein, and blood withdrawn to be sure that needle is in vein; about 1 c.c. of sclerosing fluid is injected slowly. Three or four veins may be injected at one sitting. No anæsthetic is required. It does not involve the patient giving up work or remaining in bed. Further injections can be given at weekly intervals.

NÆVI AND OTHER VASCULAR TUMOURS.

Classification.—Tumours consisting entirely of blood-vessels are of four kinds: (1) Capillary nævi—birth marks, port-wine stains, etc.; (2) Venous or cavernous nævi—chiefly dilated veins; (3) Aneurysm by anastomosis—arteries and veins which open directly into one another; (4) Cirroid aneurysm—purely arterial.

Capillary Nævi.—May be congenital, but usually develop soon after birth. Vary in size from a pin's head to half the body surface. Usually bright red or dusky red colour. May be flat or raised and nodular. When very large (e.g., half the body or over an entire limb) they are accompanied by hypertrophy of these parts. When raised and nodular they often ulcerate and bleed.

TREATMENT.—

THE APPLICATION OF SOLID CARBON DIOXIDE has now almost replaced the older methods of excision and electrolysis. The snow formed by the sudden liberation of the liquid gas is moulded into the shape of a cylinder. The end of this is firmly pressed on the nævus, which it just covers, for about one minute. Vesication follows within a few hours, and a scab replaces this later. When this falls off the scar is thin and supple. No anæsthetic is required.

SURFACE APPLICATION OF RADIUM.—Short exposures on successive days often obliterate affected capillaries, leaving a barely distinguishable scar.

Cavernous Nævi.—Usually affect the subcutaneous tissues as well as the skin. The veins are often large cavernous spaces into which arteries open directly. A whole limb on one side of the body may be involved, and this is then generally hypertrophied.

TREATMENT.—This is only possible when the nævus is localized.

EXCISION is the ideal method for small tumours.

ELECTROLYSIS for the larger ones. A current of 200 milliampères is passed through the positive pole in the form of a series of needles embedded in the mass.

RADIUM, applied as for capillary nævi. Treat by 'cross fire' irradiation if a tumour mass is present.

Aneurysm by Anastomosis.—A rare condition. It may be congenital, when it is associated with hypertrophy of the affected part. Masses of tortuous arteries and veins communicate freely with one another and produce a distinct bruit and thrill. It occurs in cancellous bones, or in the cranial diploe, or in one of the limbs.

Treatment is the same as for cirroid aneurysm.

Cirroid Aneurysm.—A mass of dilated varicose arteries. Occurs most frequently on the scalp or orbit, connected with the temporal, posterior auricular, and occipital or ophthalmic arteries, but may arise on the perineum, trunk, or limbs. A loud bruit is heard over it. The skin above and the bone beneath are atrophied by pressure. The hair falls out, and ulceration and hæmorrhage may result. Sometimes it spreads rapidly.

TREATMENT OF PLEXIFORM ANGIOMATA (aneurysm by anastomosis and cirroid aneurysm).—Excision is usually out of the question. A series of ENCIRCLING LIGATURES or an attempt to ligature all the feeding vessels is the best method. Electrolysis is the only alternative.

DISEASES OF THE LYMPHATICS.

Acute Lymphangitis.—Occurs under the same conditions as cellulitis, into which it often merges. The inflamed lymph-vessels are seen as red and tender streaks running up to enlarged glands.

The treatment is that of the primary septic focus.

Chronic Lymphangitis may accompany syphilitic and tuberculous diseases.

Division of the Thoracic Duct, which opens into the junction of the left subclavian and jugular veins, is followed by a chylous fistula.

This must be treated by LIGATURE, anastomotic channels carrying on the chyle circulation.

Lymphangiomas may be capillary or cavernous, and resemble naevi. They are often papillary, and the papillæ present clear vesicles. Their rupture gives rise to lymphorrhœa.

Cystic Hygromata, Macroglossia, and Macrocheilia consist of lymphatic dilatations of congenital origin (*see* Chaps. XXIX, XXXI, and XXXIII).

Chylous Ascites and chylous hydrocele are very rare conditions due to obstruction to thoracic duct by tumours or parasites.

Chronic Lymphatic Obstruction is due to: (1) Tuberculous or malignant disease in the glands and vessels; or (2) *Filaria sanguinis hominis*.

SIGNS of this are: (1) Solid or lymphatic œdema; (2) Hyperplasia and connective-tissue overgrowth; and (3) Lymphatic fistula with lymphorrhœa.

ELEPHANTIASIS ARABUM.—Result of infection by *Filaria* introduced by mosquito bites. The adult worm is 3 inches long, and is located in a lymph- or blood-vessel; the swarm of embryos block the lymph-vessels and give rise to the obstruction. The external genitals and legs are chiefly affected, and form huge warty hypertrophied masses.

Partial or complete AMPUTATION, or the ligation of the main arteries, are the alternative modes of treatment.

AFFECTIONS OF THE LYMPH-GLANDS.

Acute Lymphadenitis is always secondary to some septic lesion in the associated skin areas.

ANATOMY.—The glands become swollen and matted together, and peradenitis quickly follows, producing a diffuse inflammatory swelling, which soon forms an abscess.

Acute Lymphadenitis, *continued.***SITUATION.—**

IN THE SUBMAXILLARY TRIANGLE of the neck it is secondary to buccal, tonsillar, and dental diseases.

IN the POSTERIOR TRIANGLE, to pediculosis or scalp ulcers or wounds.

IN the AXILLA, to sepsis in the arm or breast.

IN the GROIN, to sepsis of the genitals, abdominal wall, perineum, and anus (this generally affects the oblique set of glands parallel to Poupart's ligament); to sepsis of the leg, especially on the inner side.

IN the HAM, to disease on the outer side of the leg and foot.

TREATMENT is by fomentations and free incisions.

Chronic Lymphadenitis may be simple, syphilitic, or tuberculous.

Tuberculous Lymphadenitis.—

ETIOLOGY.—Children or young adults. Bad food and hygiene. Frequently there is some predisposing cause for enlargement, e.g., carious teeth, tonsillitis, or pediculosis.

DISTRIBUTION.—The submaxillary, carotid, and supraclavicular glands are most often affected, and in this order; the axillary and inguinal glands much more rarely, owing to fewer predisposing causes for enlargement or points of entry for the tubercle bacillus.

PATHOLOGY.—The glands go through the following stages:—

1. Enlargement, with tuberculous infiltration.
2. Caseation, sometimes followed by calcification or cicatrization.
3. Suppuration, which may be of a tuberculous or mixed type.
4. Peradenitis always occurs before long, and serves to mat together neighbouring masses of glands and to fix the glands to surrounding tissues.

SIGNS.—Three stages are usually noted:—

1. Simple enlargement, without much tenderness, in which individual glands can be distinguished.
2. The stage of peradenitis, in which the glands become fused together and more firmly fixed in their surroundings.
3. The stage of suppuration, when an abscess (usually cold) develops. Chronic sinuses are left by the bursting of the abscesses, and if these heal they leave scars which are puckered, keloidal, and vascular.

TREATMENT.—

PALLIATIVE.—High feeding, fresh air, and removal of all local sources of irritation.

ARTIFICIAL SUNLIGHT (Kromayer lamp) used in early stages.

OPERATIVE.—This is contra-indicated when active lung disease co-exists or when the opsonic index is low. The glands must be dissected out or abscesses opened and scraped.

In the neck the incisions should be made (1) below and parallel to the jaw, (2) behind the sternomastoid, so as to leave inconspicuous scars. In bad cases it may be necessary to divide the sternomastoid or dissect out the internal jugular vein.

DIAGNOSIS.—

SIMPLE CHRONIC ADENITIS affects only one or two glands, and is stationary.

SEPTIC ADENITIS has an acute course, accompanied by signs of inflammation.

HODGKIN'S DISEASE affects many groups of glands simultaneously; the glands remain discrete longer, and do not break down. Leucopenia is present.

Other lymph-gland tumours (*see below*).

Other Varieties of Lymph-gland Enlargements.—

LYMPHADENOMA OR HODGKIN'S DISEASE.—Enlargement and overgrowth of lymphatic glands and lymphoid tissue of liver and spleen (*hard-bake spleen*). Glands remain discrete. There are three main types of the disease, cervical, mediastinal, and abdominal, according to the glands mainly affected.

TREATMENT.—Operation is useless. Arsenic and X rays.

LEUKÆMIA.—Causes swelling of glands, bones, and spleen, with characteristic blood changes, i.e., great leucocytosis.

LYMPHOSARCOMA.—Is a rare primary disease in the glands. It occurs in the neck and mediastinum. The growth is very rapid, vascular, and fatal.

SECONDARY MALIGNANT DISEASE.—Is common. Epithelioma, scirrhus, or sarcoma may arise in the neck, axilla, or groin.

CHAPTER XVI.

AFFECTIONS OF THE SKIN.

Carbuncle.—A patch of infective gangrene affecting the subcutaneous tissues.

CAUSES.—Infection with *Staphylococcus pyogenes aureus*. Albuminuria or diabetes are common antecedents. Local abrasions or contusions sometimes precede.

PATHOLOGY.—Acute inflammatory exudation is caused by the cocci. The dense fibrous tissue under the skin does not yield, and the compression strangles the vessels. Septic gangrene results from these causes. Later, the living tissues suppurate round the septic slough and form pus and granulations.

Hence, the following zones are distinguished from within outwards: (1) Central slough or core; (2) Layer of pus; (3) Layer of granulations; (4) Inflamed tissues.

Then the pus breaks through the overlying skin in one or two places and the slough is discharged, the cavity being filled up by granulation and cicatrization.

SIGNS.—Localized, red, brawny, painful, swollen area of skin, from one to six inches in diameter. There may be slight enlargement of lymph-glands. In one or two weeks the skin becomes vesiculated, and then shows several grey points. These burst, and pus oozes out. The openings run together, and some time later the slough comes away, the suppuration becoming freer all the time. The cavity left heals by granulation.

Extension may occur, especially if septic poultices are used, by infection of neighbouring hair follicles.

DISTRIBUTION.—Nape of neck, back, nates, and face are the commonest sites. Usually single.

COMPLICATIONS.—Septic thrombosis of the sinuses may occur with carbuncle of the face. Septicæmia, pyæmia, and acid intoxication with coma—especially in diabetes.

SYMPTOMS.—General malaise, without much rise of temperature. If general septic infection occurs it will cause the usual symptoms.

DIAGNOSIS.—Boils are multiple, conical, and have only one opening.

GUMMATA are painless, with but little inflammation. The edges are clean cut and sharply defined, the discharge is gummy, the slough like wet wash-leather.

ANTHRAX.—A black slough surrounded by a ring of vesicles. Very marked œdema and swelling of lymph-glands. Little local pain, but marked rise in temperature.

PROGNOSIS is good, unless albuminuria or diabetes exists, or sinus thrombosis or general septic infection occurs.

TREATMENT.—Free excision where possible, or free incisions removing as much of carbuncle tissue as possible. Carbuncles on the face, especially the upper lip, are always dangerous. Treat by early incision with thermo-cautery, and if phlebitis is present, expose angular vein and resect as high as possible.

A Furuncle or Boil is essentially the same as a carbuncle. A boil differs from a carbuncle in the following: It affects the skin only, and not the subcutaneous tissue. It opens by a single opening, instead of several. It is multiple very frequently. Usually occurs from the infection of a hair follicle or sweat gland. **FURUNCULOSIS** is a disposition to repeated crops of boils.

TREATMENT.—**LOCAL AND PROPHYLACTIC.**—Lotions of spirit and biniodide, 1-1000.

GENERAL.—Injection of staphylococcal vaccine prepared from the organisms actually present in the boils, under opsonic control.

Corn.—A hard keratinous mass of epidermis with a deep-growing conical centre, which presses on the tender parts of the deep skin.

CAUSES.—Abnormal pressure—badly fitting boots, projecting bony processes.

LOCALITY.—Toes, especially little and great, and over the prominences of talipes.

VARIETIES.—Hard or soft, according to whether they are exposed to the moisture of sweat or not.

TREATMENT.—Excision. Salicylic acid ointment or lotions. Pad to relieve pressure.

Wart.—Papilloma of the skin. Often multiple, and then usually on the hands of children. They appear sometimes quickly in crops, and disappear equally quickly. Possibly they are locally infective, i.e., they disseminate themselves.

TREATMENT.—Soften with salicylic ointment, and then touch with pure acetic or nitric acid.

VENEREAL WARTS are very large villous masses, which occur on the external genitals, glans, prepuce, or labia, as the result of the irritation of discharges.

TREATMENT.—Excision, with cautery of the base; or application of calomel or acid nitrate of mercury.

Lupus Vulgaris.—A very chronic tuberculous disease of the skin, OCCURS in children, or adults under 30. Attacks the nose, cheeks, lips, eyelids, nasal, oral, and lachrymal mucous membranes, and ears. Less often the fingers, toes, or trunk.

SIGNS.—Nodules appear deep in the skin, and then run together. Each nodule is red and raised, and resembles 'apple jelly'. The skin becomes infiltrated and ulcerated, fresh nodules appearing on the spreading margin. One edge may heal whilst the other

Lupus Vulgaris—Signs, *continued*.

extends. The ulcer is covered with granulations, and over these are thick scabs formed by the drying of the purulent secretion. Deep tissues, e.g., the cartilages of the nose or ears, are attacked and destroyed. The scars left are puckered, thin, and vascular.

COURSE.—The disease runs a course of many years, but occasionally dies out spontaneously.

COMPLICATIONS.—Epithelioma may form in the scar. Other tuberculous diseases very rarely arise.

DIAGNOSIS depends on the tuberculous nodules, the slow superficial ulceration, the congested scar tissue.

SYPHILITIC ULCERATION is much more rapid and deep. Other signs are usually present. The scars are thin, pale, and supple.

LUPUS ERYTHEMATOSUS.—See *below*.

TREATMENT.—Removal by scraping, and the subsequent application of caustics, e.g., zinc chloride.

Finsen light or X rays

Vaccine treatment by a vaccine composed of tuberculin, and usually another vaccine prepared from the patient to combat the septic infection by staphylococci.

Lupus Erythematosus.—

OCCURS generally in adult women, on the face in symmetrical patches, like a butterfly, the wings on the cheeks and the body on the nose.

SIGNS.—Smooth hyperæmic patch, covered with a fine branny desquamation. Associated with some seborrhœa. It does not ulcerate, but leaves a thin white scar surface in the middle, whilst the edge spreads.

TREATMENT.—Tar and mercury ointments. Finsen light.

AFFECTIONS OF THE NAILS.

Onychia, or Períonychia.—An inflammation of the nail matrix.

SEPTIC ONYCHIA is an ungual whitlow caused by a septic wound. Pus collects under the nail.

TREATMENT.—Removal of the nail and scraping the granulations.

SYPHILITIC ONYCHIA occurs in congenital and acquired syphilis in the secondary stage. It yields to mercury.

Ingrowing Toe-nail.—Usually affects the great toe.

Caused by boot pressure, the edge of the nail being pressed into the soft tissues and causing a chronic ulceration.

TREATMENT.—Removal of nail and thorough scraping of the matrix.

Onychogryphosis.—A deformed and overgrown great-toe-nail seen in old people. When it becomes painful it should be removed.

AFFECTIONS OF THE SEBACEOUS GLANDS.

Adenoma Sebaceum, or Lipoma Nasi.—Forms a bulbous hypertrophied mass on the skin of the nose.

Carcinoma Sebaceum causes a rodent ulcer (*see* p. 74).

TREATMENT.—(1) Excision of the whole thickness of the affected skin and subcutaneous tissue, with half-an-inch margin of healthy tissue; subsequent skin grafting. (2) Repeated exposure to the X rays. This is suitable for inoperable cases, and those where removal would cause great deformity, or when operation is refused. (3) Radium. This acts much more rapidly and effectively than the X rays.

Sebaceous Cysts.—

OCCUR on any part of the body, but especially on the hairy parts, on the scalp behind the ears, or in the eyelids.

SIGNS.—A fluctuating swelling in the skin which moves freely over subjacent tissues. A blocked mouth of a sebaceous gland is often seen.

ANATOMY.—The cyst wall may be epithelial, or calcareous from degenerative changes (atheromatous), or it may present adenomatous growth. The contents are pultaceous, and consist of fat, epithelial debris, and cholesterol. They may form a calcareous mass.

COMPLICATIONS.—

A SEBACEOUS HORN may grow up by superposition of successive layers of epithelium.

A FUNGATING ADENOMA may follow its rupture.

DIAGNOSIS.—

DERMOID CYSTS occur in special situations and always lie deep to the skin.

LIPOMATA are below the skin and are lobulated.

ABSCESSES have a more rapid course and affect the deeper tissues.

TREATMENT.—Dissect out.

Molluscum Contagiosum.—Yellowish-white umbilicated nodules about the size of a pea.

OCCURS on the face, or less often on other parts of the skin.

CONSISTS of a central core of epithelial cells supported by a fibrous stroma. Bodies like psorosperms are found, but are the result of cell degeneration.

They are locally contagious.

TREATMENT by excision.

CHAPTER XVII.

INJURIES AND DISEASES OF NERVES.

INJURIES OF NERVES.

Causes.—

TRACTION DURING BIRTH	} Producing rupture of some or all of the nerve fibres.
CONTUSIONS AND STRAINS	
DISLOCATIONS AND FRACTURES	

PRESSURE: Growth of tumours—Aneurysm—Displaced bones (fracture, dislocation, cervical rib)—Inclusion in callus—Pressure of crutches or splints—Inflammatory products in bony canals.

WOUNDS.

Effects of Total Division of a Mixed Nerve.—

IMMEDIATE.—Paralysis of muscles. Anæsthesia of skin: only partial, owing to the overlapping of sensory areas. Vasomotor paralysis, producing first hyperæmia then anæmia of parts. Glands do not respond to ordinary stimuli.

LATE EFFECTS OF NERVE DIVISION:—

CHANGES IN THE NERVE.—Retraction of divided ends.

Formation of a hæmatoma, especially at the proximal end.

Organization of the hæmatoma into a bulbous nerve-end (traumatic neuroma). This contains bundles of new nerve fibrillæ embedded in fibrous tissue.

The peripheral end shrinks and atrophies.

Wallerian degeneration occurs below the injury, and above as far as the first Ranvier's node. Begins at the fourth day after injury. Medullary substance breaks up into fat globules. Axis cylinders disappear in one month. Nuclei of neurilemma proliferate. Leucocytes invade and replace the nerve fibres.

CHANGES IN MUSCLES.—Muscle cells atrophy, or are replaced by fibrous tissue and fat. Deformities occur from unopposed action of the unparalysed muscles.

ELECTRICAL REACTIONS.—Excitability by faradic current is rapidly lost. Excitability by galvanic current is at first increased, and lost only very slowly. The response to galvanism is a peculiar sluggish contraction called 'the reaction of degeneration'. A greater contraction occurs at the anode than at the kathode on closing the current. As long as any response to electrical stimuli remains there is hope of repair.

SENSORY CHANGES.—Peripheral sensory nerves are of three kinds physiologically.

1. **NERVES OF DEEP SENSATION.**—These perceive deep pressure and pain, and the movements and position of bones and joints. They probably run in the muscles, tendons, and bones, and their functions are seldom if ever lost by peripheral nerve division.
2. **PROTOPATHIC NERVES.**—These respond to painful skin impressions, e.g., a prick, and distinguish extreme temperatures. Their area of distribution is badly localized, and stimulation of them gives a widely radiating, tingling feeling. They are concerned with the production of reflex movements.
3. **EPICRITIC NERVES.**—These distinguish light touches, e.g., by a hair or brush, and also small differences of temperature. They convey a well-localized sensation.

IN DIVISION OF A SENSORY NERVE: (1) are unaffected; (2) are affected over a small and variable extent, as there is much overlapping of adjacent protopathic nerves; (3) are affected over a constant and well-defined area, considerably larger than that of (2).

IN DIVISION OF A POSTERIOR ROOT there is always a larger loss of protopathic sensation than of epicritic. Thus the peripheral nerve is the unit of epicritic nerve supply, and the posterior root is the unit of protopathic nerve supply.

CHANGES IN THE JOINTS.—A plastic synovitis occurs, resulting in ankylosis. Especially noticed in the small joints of the fingers.

TROPHIC CHANGES.—

- a. **IN COMPLETE DIVISION** of the nerve without irritation or neuritis. Skin becomes rough, scaly, and cedematous. Glands atrophy, and hence the skin is very dry. Atrophy of the bones or cessation of growth occurs. Hair and nails break, or fall off.
- b. **WHEN THE DIVIDED NERVE IS IRRITATED** (the commonest condition). Skin is thin, shiny, bluish red—'glossy skin'. Vesicular and pustular eruptions occur. Chilblains are common. Excessive sweat secretion. Ulcers and whitlows. Hair falls out or breaks off. Nails are brittle and ridged, or lost by perionychia.
- c. **IN BOTH CASES.**—Temperature falls as much as 8° F. in affected parts.

CHANGES IN THE CENTRAL NERVOUS SYSTEM.—Spasms of a reflex nature; epileptic fits and dementia (both very rare).

RÉCOVERY OF A DIVIDED NERVE.—Can only occur when the two ends are brought close together, an inch separation being probably a maximum. The bulbous nerve end offers great obstacles to repair.

Recovery of a Divided Nerve, *continued*.

New axis cylinders: (a) Grow down from proximal to distal part; (b) Develop in the distal segment.

Protopathic sensation returns first, and with it the tendency to trophic changes (blisters, etc.) disappears. This takes place in periods varying from six weeks to one year.

Epicritic sensation is the last function to be recovered, and the recovery is seldom, if ever, complete. It returns in six months to two years or more.

The time at which sensory recovery begins does not vary with the position of the lesion, but the time occupied by the recovery varies directly with the distance between the point of section and the periphery.

Motor recovery takes place first in the muscles nearest to the point of section, and eventually is more complete than the sensory recovery.

Timel's sign of recovery after suture.—Pressure over the nerve trunk causes tingling in the area of distribution of the nerve. As regeneration proceeds, the point where pressure produces this sign is further from the point of injury and nearer to the periphery.

Effects of Partial Division of a Mixed Nerve.—

MOTOR CHANGES.—Instead of the typical reaction of degeneration, there is, with failure of reaction to the faradic current, a ready and brisk reaction to galvanism, with no polar reversal.

SENSORY CHANGES.—Loss of epicritic sensation is the most marked and most constant sign.

A considerable portion of a mixed nerve can be divided, up to about one-third of all its fibres, without producing any appreciable effect.

Treatment.—

IF COMPLETE DIVISION is diagnosed.—

OPERATE immediately on all important nerves. Refresh the ends, and sew together. Prevent tension by tension sutures, and also by the position of the part.

SECONDARY SUTURE may be undertaken up to three years from the injury.

IF ONLY PRESSURE or partial laceration exists.—

Wait to see whether natural recovery will take place

Diagnosis of Nerve Division has to be made from:—

SPINAL CORD INJURY.—In this there is total loss of sensibility to either pain, heat, cold, tactile sensation, or deep sensation over a given area opposite to the side of the lesion, combined with a loss of movement and the sensation of passive movement on the same side as the lesion.

HYSTERIA.—In this there is a complete loss of all forms of sensation over an area the upper margin of which is a simple

circle, constituting the so-called 'glove' or 'stocking' anæsthesia. With this there may be a flaccid paralysis, but the electrical reactions are quite unchanged.

ISCHÆMIC PARALYSIS.—In this there may be areas of sensory loss with trophic changes, but the characteristic shortening of the flexor muscles without actual paralysis provides the clue.

INFANTILE PARALYSIS.

(*Anterior Poliomyelitis.*)

Nature of the Disease.—A selective inflammation of the anterior-horn cells in the spinal cord, infective in character, due to the presence of the virus discovered by various workers but closely associated with the name of Flexner.

Course and Treatment.—The disease begins acutely with febrile symptoms, and in a few hours paralysis is evident and may affect any part or parts of the body. It affects most often the lower limbs, and may select one group of muscles and not another. It is a flaccid paralysis, with no sensory changes. Three stages may be recognized :—

1. **ACUTE STAGE.**—Malaise. Fever. Paralysis. Hyperæsthesia, Pains in limbs.

TREATMENT.—Intrathecal injections of Flexner's serum over the area corresponding to the affected limbs. Whole body to be fixed in bed or upon a padded frame. Limbs to be placed in light splints to maintain them in good position. No massage or electrical treatment till all pain has disappeared from the limbs, which is usually about six weeks: movement during this stage produces a sympathetic congestion in the area of the cord affected, and merely increases and perpetuates the paralysis.

2. **STAGE OF RECOVERY.**—The paralysis, which is widespread at first, is largely recovered from, leaving isolated muscles or muscle groups paralysed.

TREATMENT.—Massage and electrical treatment to affected limbs is usually given, but the value of electricity is disputed. Splints to prevent deformity. Re-education in movements.

3. **STAGE OF PERMANENT PARALYSIS.**—Certain muscle groups are finally paralysed, and unless prevented, their opponents will certainly distort the limbs. Deformities are due to the unbalanced pull of the healthy muscles. With proper treatment in the first and second stages there ought to be no contractures or deformities requiring correction.

TREATMENT may be of the following kinds :—

1. *Provision of splints*, e.g., jointed caliper for the leg, which will prevent deformity when the limb is used.

Infantile Paralysis—Treatment, continued.

2. *Correction of deformities*—by tenotomy, or by weight traction, or successive plasters. The commonest operations are tenotomy of hip flexors, or knee flexors, or of the tendo Achillis.
3. *Arthrodesis or fixation of a joint* of which all the muscles are paralysed. The common example of this is fixation of the ankle or tarsal joints for flail foot.
4. *Transplantation of tendons*. This is only possible when there is a suitable healthy muscle to take the place of the paralysed one—e.g., the peroneus longus may be brought across the front of the foot to replace the tibialis anticus. (*See also* TALIPES, p. 194.)

NEURALGIA.

Definition.—Pain in the area of a nerve distribution without any primary nerve lesion. Pain often recurs daily at the same time.

Varieties.—

1. SYMPTOMATIC OR SECONDARY.—

Toxic, e.g., malarial, gouty, lead.

REFLEX, e.g., neuralgia secondary to carious tooth or glaucoma.

PRESSURE, e.g., of aneurysm or new growth, on nerve roots.

2. IDIOPATHIC OR PRIMARY.—Commonest in the fifth nerve. Also in Intercostals—Breast—Ovaries—Testes—Joints.

IDIOPATHIC NEURALGIA.

With especial reference to Trigeminal Neuralgia.

Etiology.—Cause unknown. An ascending neuritis with arterio-sclerosis has been suggested, but not demonstrated. Women more often than men. Generally after 40.

Symptoms.—

PAIN—Paroxysmal attacks (epileptiform). The second or third division of the nerve is alone affected at first, but soon the attacks involve the other two divisions. First escapes longest. Each attack lasts only a few seconds to a minute. Pain during the attack is excruciating, sharp, and lancinating. Attacks at first are infrequent, but recur more often. Attacks are often brought on by sensory stimuli, e.g., cold draught, brushing the hair. Constant aching pain follows the paroxysm, and may last until the next.

SENSORY AND TROPHIC CHANGES.—Pressure over nerve trunks is very painful. Skin tender, and at places hyperæmic and cedematous. Profuse sweating, with lacrymation and increase of nasal discharge. Skin gets smooth and shiny; hairs fall out.

MOTOR SYMPTOMS.—Associated muscles thrown into reflex spasms or twitchings.

Treatment of Idiopathic Trigeminal Neuralgia.—

DRUGS.—Salicylates, quinine, iodides, croton chloride. All lose their effects rapidly. Avoid morphia at all costs.

OPERATIVE.—

1. NERVE STRETCHING AND DISTAL NEURECTOMY give such temporary relief that they are not used now.

Lingual neurectomy is often performed for cancer of tongue.

Inferior dental nerve may be removed for toothache.

2. PROXIMAL NEURECTOMY.—Nerves are removed at their exit from the skull. The zygoma and part of the ramus of the jaw are dislodged, and the second and third divisions removed as near the skull as possible, together with Meckel's ganglion.

Very difficult operation. Apt to be incomplete, and therefore is uncertain in its results. Produces adhesions round temporomaxillary joint.

3. EXCISION OF GASSERIAN GANGLION.—This is the only method so far which has given permanent results.

Pterygoid Route.—Zygoma and coronoid process turned aside—Second and third divisions found—Base of skull trephined outside foramen ovale—Ganglion torn out piecemeal.

Temporal Route (Hartley Krause operation.)—Horse-shoe flap down to the bone, with base at zygoma. Bone turned back in osteoplastic flap, or removed by trephine for $1\frac{1}{2}$ inch circle. Dura mater pushed back. Middle meningeal artery tied or plugged. Ganglion removed after cutting second and third divisions. Eyelids ought to be sewn together for ten days to protect from irritation, otherwise corneal ulcer and blindness may follow.

This is the method of choice in all severe cases.

4. DIVISION OF THE SENSORY ROOT OF THE GASSERIAN GANGLION through the same route as in the last operation. This is now regarded as the best method, because it causes much less bleeding, is less likely to cause trophic injury to the eye, and does not paralyse the muscles of mastication.
5. INJECTION OF THE BRANCHES OF THE NERVE with 80% alcohol. This is done through a long needle thrust into the cheek so as to lie above the sigmoid curve of the jaw, and an endeavour is made to enter the foramen ovale or the sphenomaxillary fossa, in order to inject the actual nerve trunks near the ganglion. Results are good for a year or more, and it can be repeated.
6. INJECTION OF GASSERIAN GANGLION.—The needle is thrust through the mouth in the angle between the upper jaw and the cheek, opposite the second molar tooth, until the base of the skull is struck. The point of the needle is guided into the foramen ovale, and about 1 c.c. of alcohol injected into the ganglion. The effect will be more profound and more lasting than by the last method, but there is a danger of injecting the sub-arachnoid space and so damaging other nerves.

AFFECTIONS OF SPECIAL NERVES.**Optic Nerve.—**

RUPTURED by fracture through anterior cranial fossa.

COMPRESSED or INFLAMED by intracranial diseases, especially meningitis and tumours.

INJURED by orbital growths, hæmorrhage, or cellulitis.

SYMPTOMS.—Blindness, optic atrophy, or optic neuritis.

Third Nerve.—

INJURED by fractures through sphenoidal fissure—Orbital tumours or aneurysms.

DISEASED by syphilitic disease of brain.

SYMPTOMS.—Ptosis, or drooping of upper eyelid—External squint—Diplopia when looking inwards—Dilated pupil—

Loss of accommodation—Slight exophthalmos.

Fourth Nerve.—Injuries and diseases as in the case of the third.

SYMPTOMS.—Squint and diplopia when looking downwards.

(For diseases of the fifth nerve *see* TRIGEMINAL NEURALGIA, p 164.)

Sixth Nerve.—Injuries and diseases as in the third.

SYMPTOMS.—Internal squint—Diplopia when looking outwards.

INJURIES AND DISEASES OF THE SPHENOIDAL FISSURE OR CAVERNOUS SINUS produce: Paralysis of all the muscles of the eye—Anæsthesia of the cornea and forehead—Venous congestion of the eye and conjunctiva.

OPHTHALMOPLÉGIA EXTERNA, i.e., paralysis of all the external eye muscles, without congestion, is caused by syphilitic or tabetic disease of the floor of the third ventricle.

Seventh, or Facial Nerve, or its centres, may be diseased or injured anywhere between the cerebral cortex and the branches of distribution.**INTRACRANIAL LESIONS.—**

CEREBRAL CORTEX.—Injury—Pressure—Hæmorrhage. Part of the opposite side of the face paralysed.

CORONA RADIATA.—Hæmorrhage or thrombosis. Lower half of opposite side of face paralysed. Eyelids and occipitofrontalis (supplied by both sides of cortex) escape. Combined with paralysis of arm, and perhaps of leg.

IN PONS.—Hæmorrhage or growth. Paralysis, with atrophy of the same side of the face from affection of the facial nuclei. Paralysis of the opposite side of the body from affection of the pyramidal tract of the opposite side above the decussation of the pyramids.

NERVE ROOT between the brain and the bone.—Injuries or tumours. Paralysis of the whole of the same side of the face. Generally associated with nerve deafness.

CRANIAL LESIONS.—

FRACTURE OF THE BASE OF THE SKULL running through the internal auditory meatus. Causing immediate laceration of the nerve, or later implication in callus.

OTITIS MEDIA causing compression of the nerve in the aqueductus Fallopii.

INJURY OF NERVE during mastoid operations.

A loss of taste in the anterior two-thirds of the side of the tongue follows a division of the nerve between the geniculate ganglion and the point where the chorda tympani leaves the trunk.

EXTRACRANIAL LESIONS.—Injury of the nerve by operations—Cold or inflammation—Tumours (especially malignant) of the parotid. Produce total facial paralysis.

FACIAL PARALYSIS.—

SYMPTOMS (total paralysis).—Eyelids cannot be closed. Eyeball is rolled up on attempting to shut eye. Corneal ulceration sometimes results from exposure. Epiphora from want of apposition of lower eyelid to eye. Face immobile and wrinkles smoothed out. Face drawn to opposite side. Cheek is flabby, and food collects between cheek and teeth from paralysis of buccinator.

PROGNOSIS.—In cerebral hæmorrhage—recovery generally takes place. In pontine hæmorrhage—atrophy occurs and recovery is rare (patient usually dies). In intraosseous lesions—slow recovery is the rule. When the trunk of the nerve is divided, paralysis may be permanent.

TREATMENT.—Expectant in most cases. When paralysis is permanent: Grafting the hypoglossal or part of the spinal accessory nerve into the trunk of the facial.

In old cases benefit may be obtained by grafting a slip of the masseter muscle into the angle of the mouth. This cures the relaxed cheek and drooping mouth.

FACIAL TIC OR HISTRIONIC SPASM.—Caused by some obscure central irritation. Results in involuntary clonic spasms of one side of the face.

TREATMENT.—Stretching the facial nerve.

Auditory Nerve and its Centres.—Tumour or injury of the opposite temporosphenoidal lobe, fracture of the base of the skull through internal meatus, produce incurable deafness.

Vagus.—

TRUNK is injured by: Fractures through the jugular foramen—Operations or tumours in the neck.

SYMPTOMS: Vomiting—Inhibition of heart's action—Palpitation—Laryngeal paralysis.

Vagus, continued.

THE RECURRENT LARYNGEAL NERVE is injured by sub-clavian aneurysm on the right side—Aortic aneurysm on the left side—On both sides by injuries, operations, or malignant growths in the neck.

Produces laryngeal paralysis—especially abductor paralysis.
Hoarse voice Asphyxia if bilateral.

Eleventh or Spinal Accessory Nerve.—

INJURED OR DIVIDED BY:—

a. Fractures through the jugular foramen.

Produce paralysis of larynx and pharynx through affection of accessory portions. Paralysis of sternomastoid and trapezius (partial).

b. Operations in the neck, especially those for removal of glands. Produce paralysis of sternomastoid (slight), and more complete of trapezius, with wasting and drooping of shoulder.

SPASMODIC WRY NECK.—Clonic contraction of the sternomastoid and the small rotator muscles of the head. (*See p. 186.*)

Hypoglossal Nerve.—Injured by wound or operation in neck, or by carotid aneurysm or tumour. Produces unilateral paralysis and hemi-atrophy of tongue. The tongue when protruded deviates to the same side of the mouth.

Sympathetic Nerve in the Neck.—May be involved by tumours, or injured by stabs. Irritation produces dilatation of the pupil and widening of the palpebral fissure, with exophthalmos. Also unilateral sweating.

Paralysis produces contraction of the pupil, narrowing of the palpebral fissure, retraction of the eye, and dryness of skin.

Phrenic Nerve.—Arises from the third, fourth, and fifth cervical and goes to the diaphragm. Wounds in the neck may divide it, but unilateral division causes no symptoms. Irritation of the nerve is said to cause cough or hiccup.

Brachial Plexus.—

CAUSES OF INJURY.—

SUPRACLAVICULAR.—(*a*) Indirect violence. Excessive or sudden traction on the arm in attempting to save a fall, or at birth.

(*b*) Direct injury. Cervical rib, fractured clavicle, or stab wounds. Usually affects the first dorsal.

INFRACLAVICULAR.—The various incidents during and after dislocation of the shoulder-joint.

DISTRIBUTION OF THE BRACHIAL ROOTS.—

THE POSTERIOR ROOTS.—Of these only two have well-defined areas of distribution, viz., the fifth cervical and the first dorsal, lesions of which cause a pre-axial and post-axial anæsthesia of the arm respectively.

THE ANTERIOR ROOTS.—

Fifth cervical—the deltoid, rotators, biceps, coracobrachialis, brachialis anticus, supinators, and rhomboids.

Sixth cervical—pronators, radial extensors, clavicular part of pectoralis major, serratus magnus.

Seventh cervical—triceps, ulnar extensors, finger extensors, lower part of pectoralis major.

Eighth cervical—flexors of wrist and fingers.

First dorsal—intrinsic muscles of the hand.

There are three common types of brachial plexus injury :—

1. **WHOLE PLEXUS.**—All the muscles of the arm are paralysed except the rhomboids and serratus. There are usually some signs of injury of the cervical sympathetic. In SUPRACLAVICULAR rupture sensation is lost over the whole arm except on the inner side adjacent to the axilla, which is supplied by the intercosto-humeral nerve. In INFRACLAVICULAR rupture the loss of sensation is complete.
2. **UPPER ARM OR ERB-DUCHENNE TYPE.**—Essentially a rupture of the fifth cervical anterior primary division. It is commonly caused by traction on the arm in a direction towards the feet. Paralysis of the deltoid, rotators, biceps, brachialis anticus, and supinators. The arm lies at the side, and the forearm is pronated. There is no loss of sensation. Occasionally the deltoid and rotators alone are paralysed from a partial rupture of the fifth cervical in its upper part.
3. **LOWER ARM OR KLUMPKE TYPE.**—Is caused by a rupture of the eighth cervical and first dorsal nerve. Caused by traction on the arm upwards. Paralysis of the intrinsic muscles of the hand, with sympathetic paralysis. Sensation is lost over the inner side of the arm and forearm.

THE INNER CORD OF THE PLEXUS may be injured by a subcoracoid dislocation. The symptoms are those of injury of the ulnar nerve, together with the small hand muscles supplied by the median (inner head of the median).

THE OUTER CORD OF THE PLEXUS is occasionally injured in dislocations. There will be paralysis of the biceps, coracobrachialis, and of all the muscles supplied by the median, except those in the hand.

THE POSTERIOR CORD is the most rarely injured part of the infraclavicular plexus. The symptoms will be those of lesions of the musculospiral and circumflex nerves.

Cervical Rib.—

ANATOMY.—The transverse process of the seventh—sometimes the sixth—cervical vertebra grows out and joins the rib below. In this course the cervical rib passes through the brachial plexus, and it may compress the lower part of this, together with the subclavian artery, between itself and the first true rib.

Cervical Rib, continued.

ETIOLOGY.—It is much commoner in females, usually bilateral, only a small proportion cause any symptoms, and these are then usually unilateral and on the right side. The symptoms first appear between the ages of twenty and thirty.

SYMPTOMS.—**GENERAL WEAKNESS** of the whole limb, noticed at the end of the day or after severe muscular exertion.

MUSCULAR WASTING, affecting chiefly the interossei, thenar, and hypothenar muscles.

PAIN shooting down the inner side of the arm and forearm into the ulnar side of the hand, also some tingling or spasticity of the inner fingers.

ALTERED PULSE. There is often a noticeable bruit over the subclavian artery, with a diminished pulse on the affected side. There may be cyanosis and coldness of the arm.

TREATMENT.—Excision of the rib and its periosteum.

Posterior Thoracic, or Nerve of Bell, which arises from the fifth, sixth, and seventh cervical nerves, and goes to the serratus magnus, is often paralysed by itself as the result of injury or neuritis.

SIGNS.—Winged scapula. Inability to raise the arm above a right angle.

The Circumflex Nerve may be injured by blows, by fractures of the surgical neck of the humerus, or by dislocations.

SIGNS.—Paralysis and wasting of the deltoid and teres minor, with anæsthesia over the lower two-thirds of the deltoid.

The Musculospiral with its posterior interosseous branch is the most commonly injured of all the spinal nerves.

CAUSES.—Fractures and dislocations of the humerus and shoulder. Pressure of crutches at the posterior axillary fold. Pressure on the arm under the body during anæsthesia or a drunkard's sleep. Gunshot wounds. Fracture, usually gunshot, of the neck of the radius (affects posterior interosseous only).

SYMPTOMS.—Paralysis and wasting of the triceps, supinators, and extensors of the thumb, fingers, and wrist.

Wrist-drop is the most prominent sign, the hand being held in a position of pronation (*Fig. 31*). The fingers and thumb cannot be properly extended, but the terminal phalanges of the fingers can be extended by the interossei.

Anæsthesia.—If lesion is in upper third of arm (rare), there will be sensory loss over the back of the radial side of hand and thumb. If the lesion is in the lower third of the arm (common type), there is no sensory loss, owing to the fact that the external cutaneous branches of the musculospiral anastomose with the external cutaneous nerve, which in its turn anastomoses with the radial

nerve. In the same way division of the radial nerve high up in the forearm produces no sensory loss.

If the lesion is below the elbow, the long supinator and the radial extensors will escape and there may be no wrist-drop, but only loss of extension in the thumb and fingers.

TREATMENT.—Whilst waiting for operative treatment, and during the whole period of recovery, a dorsiflexion ('cock-up') wrist splint (*Fig. 32*) must be worn, in order to prevent the extensor muscles becoming stretched.

Tendon Transplantation.—When nerve suture has failed or is impossible, tendon transplantation gives a good result. From the flexor group the following muscles are isolated: flexor carpi radialis, pronator radii teres, palmaris longus, and flexor carpi ulnaris. These are cut as low down as possible and joined to: (1) The extensors of the wrist; (2) The extensors of the thumb; and (3) The extensor of the fingers.

Median Nerve.—Usually injured by wounds above the wrist.

SYMPTOMS.—Paralysis and wasting of three short thumb muscles (the abductor, opponens, and part of the flexor brevis), with defective opposition of the thumb movement, also of the outer two lumbricals, which, if the interossei are intact, give no sign (*Fig. 33*).

The paralysis of the opponens pollicis is manifested by inability to bring the thumb across the hand parallel to the palmar surface. It is difficult to detect, because the flexors and adductors together may simulate this movement.

Anæsthesia (epicritic loss) of palmar aspect of thumb and adjacent two-and-a-half fingers, and of the dorsal aspect of the last, or last two, phalanges of the same (*Fig. 34*). Trophic changes will be evident.

If the nerve is injured at the elbow or in the upper arm; Paralysis of both pronators, with loss of pronation and of all the flexors, except part of the flexor profundus and the flexor carpi ulnaris.

If the ulnar nerve also is divided, the deformity shown in *Fig. 35* results.

Ulnar Nerve.—

CAUSES OF INJURY.—Wounds or dislocations, especially in the neighbourhood of the elbow.

SYMPTOMS.—Paralysis of the lumbricals (inner two) and all the interossei, causing the *main-en-griffe*, i.e., hyperextension of the metacarpo-phalangeal joints and flexion of the two inter-phalangeal joints (*Fig. 36*). Wasting is seen between the metacarpals.

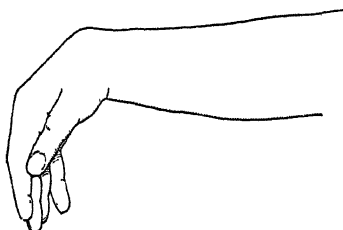


Fig. 31.—Musculospiral nerve paralysis.



Fig. 32.—The short 'cock-up' wrist splint.



Fig. 33.—Median nerve paralysis—'ape hand'.

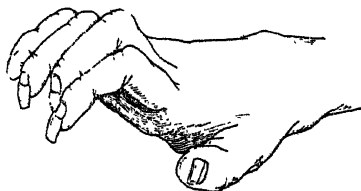


Fig. 35.—Median and ulnar nerve paralysis.

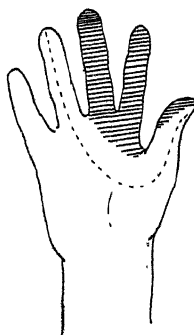


Fig. 34.—Loss of sensation produced by division of median nerve. In this figure and in Fig. 37 the dotted line marks the limit of loss of sensation of touch, the shaded area that of pain.

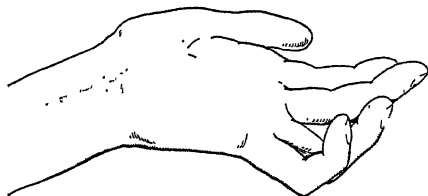


Fig. 36.—Ulnar nerve paralysis.

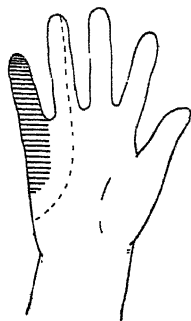


Fig. 37.—Loss of sensation produced by complete division of ulnar nerve.

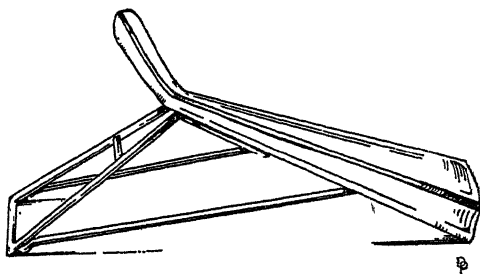


Fig. 38.—Verrall's splint

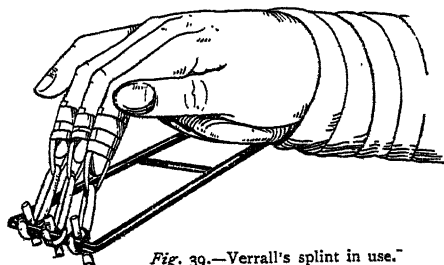


Fig. 39.—Verrall's splint in use.

Ulnar Nerve—Symptoms, *continued*.

Paralysis of the adductor muscles of the thumb, and all the short muscles of the little finger, with wasting at the thenar and hypothenar eminences.

The paralysis of the adductors is shown by inability to bring the thumb against the index finger in a direction at right angles to the palmar surface. The long flexor or extensor may simulate this movement.

Paralysis of the flexor carpi ulnaris and part of the flexor profundus, with weakened hand-grasp and tendency to radial abduction of the hand.

Anæsthesia (epicritic loss) of the little and half the ring fingers back and front. Also of the ulnar part of the hand (*Fig. 37*).

If divided just above the wrist, only the hand paralysis is seen, and there is no dorsal anæsthesia.

In all cases deep sensibility in the hand is lost only when the nerve is divided high up before it goes to the muscles, or when the flexor tendons as well as the terminal nerves are divided.

SPECIAL SPLINT FOR ULNA AND MEDIAN LESIONS.—

The clawed fingers should be gradually brought down by a combination of axial traction and flexion on a special Verrall's splint (*Figs. 38 and 39*).

The Cauda Equina may be injured by falls and blows apart from or together with injuries of the spine. The sensory loss is of the root type, i.e., the protopathic is larger than the epicritic loss, usually being limited to a saddle-shaped area on the buttocks.

DISTRIBUTION OF THE NERVES OF THE SACRAL PLEXUS.—

Fourth lumbar—the posterior muscles of the leg below the knee and the tibialis anticus.

Fifth lumbar—the anterior leg muscles (except the tibialis anticus) and the peronei.

Second sacral—the glutei and hamstrings.

Third and fourth sacral—the levator ani, sphincter ani, and perineum.

The Sciatic Nerve is very seldom injured, except by gunshot wounds, owing to its deep position and great strength. The signs are those of internal and external popliteal nerve injuries (*see below*), combined with paralysis of the hamstrings.

The external division (external popliteal) is often injured, whilst the internal escapes. In lesions of the whole nerve there is a very limited sensory loss on the inner side of the leg.

SCIATICA is neuralgia of the sciatic nerve.

CAUSES.—(a) Doubtful nature, e.g., cold, neuritis, rheumatism, gout, syphilis; (b) Pressure on the nerve, inside or outside the pelvis, by abscesses, aneurysm, or new growths;

(c) Pressure on the nerve roots by caries, new growth, or injuries of the spinal column; (d) Chronic spinal cord diseases, e.g., tabes.

SYMPTOMS.—Pain down the back of the thigh, increased by pressure on the nerve, or by flexing the hip-joint when the knee is straight (stretches the nerve).

TREATMENT.—Drugs suitable for rheumatism, neuritis, etc. Absolute immobility for several weeks by bandaging the limb to a long Liston's splint. Nerve stretching.

External Popliteal Nerve.—May be torn or injured as it winds round the biceps tendon and neck of the fibula.

SYMPTOMS.—*Anæsthesia* of the dorsum of the foot and *paralysis* of the extensor and peroneal muscle groups. *Talipes equinovarus* results.

TREATMENT.—Foot-drop must be prevented before nerve suture and during recovery, by a toe-raising spring. When nerve suture is impossible or has failed, the foot may be kept raised by making a hole in the crest of the tibia at its lower third and passing the tendons of the tibialis anticus and peroneus longus (cut from their muscles) through this hole, drawing them tight and sewing them in this position.

Internal Popliteal Nerve.—Is seldom injured. Paralysis of the calf and flexor muscles of the toes, with some *anæsthesia* of the sole of the foot, and *talipes calcaneo-valgus*.

Anterior Crural Nerve.—Is seldom affected. Its injury causes paralysis of the quadriceps extensor muscle and sartorius, with flexion of the knee and *anæsthesia* of the greater part of the thigh and leg.

TREATMENT.—The flexor muscles of the knee may be brought forward to act as extensors, by attaching them to the patella. The biceps on the outer side, and the semitendinosus and gracilis on the inner, may thus be transplanted.

THE SYMPATHETIC NERVOUS SYSTEM.*

Anatomy.—Two sympathetic cords or trunks run, one on each side, from the base of the skull to the coccyx, lying on the side and front of the vertebral column. Each has ganglia upon it, three in the cervical portion, and one for each vertebral segment below (D 12, L 5, S 5). The ganglia are connected with the corresponding spinal nerves by white (medullated) and grey (non-medullated) rami communicantes. Nerves issue from the sympathetic ganglia to the plexuses of nerves situated along the course of the great blood-vessels and around the thoracic and abdominal viscera (cardiac, cœliac, solar, hypogastric plexuses).

* G. Jefferson, *Medical Annual*, 1932, 507.

The Sympathetic Nervous System, *continued*.

Physiology.—The sympathetic nerves serve to innervate the unstriated muscle of the blood-vessels and viscera. They serve to maintain tone or tonic contraction of the vessels, of the voluntary muscles, and of parts of the viscera. They are complementary or antagonistic to the action of the vagus nerves in the abdomen. Thus they cause spasm of sphincters at the pylorus and ileocaecal valve, but inhibit the action of the vagus in causing peristalsis of the bowel. They have an important rôle in the causation of pain, especially in the deep pain of viscera.

Ramisection.—Hunter and Royle suggested that in certain cases of cortical lesions associated with spastic paralysis (e.g., Little's disease, cerebral diplegia) the spasm of the muscles was kept up by unbalanced sympathetic influence. Section of the grey rami communicantes going to the cervical or lumbar spinal nerves was done in order to lessen this spasm. It is doubtful whether these operations have any lasting result.

Peri-arterial Sympathectomy.—Most of the sympathetic fibres to the limbs run in the sheath of the vessels. Hence, stripping a portion of the main artery, or injecting alcohol into its sheath, will paralyse the sympathetic action, i.e., cause vasodilatation. But this action is of such a temporary character that it is not of much value. It has been done for Raynaud's disease, and in the lower leg to promote healing of chronic ulcers or indolent fractures.

Ganglionectomy.—This operation—i.e., the excision of one or more of the ganglia of the sympathetic chain—has the same effect as peri-arterial sympathectomy, but produces a much more lasting result. Three chief indications are :—

RAYNAUD'S DISEASE.—Excision of the stellate ganglion through a posterior incision is performed. The neck of the first rib and the first dorsal transverse process are excised. The ganglion is found between the C8 and D1 nerves. It is best to remove the first dorsal ganglion as well as the lowest (stellate) cervical ganglion.

THROMBO-ANGIITIS OBLITERANS.—If the arteries are not too much occluded, and if there is a sufficient collateral circulation, this will be shown by the improvement in circulation (rise of temperature, improved colour, etc.) caused by spinal injection of novocain. Resection of the 3rd and 4th lumbar ganglia on both sides is then likely to produce lasting alleviation.

MEGACOLON OR HIRSCHSPRUNG'S DISEASE.—In this and in certain cases of obstructive colonic stasis, ganglionectomy has given most promising results. Some indication of this may be gained by noting the effect of spinal anæsthesia in causing bowel evacuation. The lumbar chain is removed on both sides with the 3rd and 4th ganglia.

Resection of the Presacral Nerves.—For cases of intractable pain caused by cancer of the rectum or uterus and bad cases of dysmenorrhœa, the lower part of the aortic plexus and the nerves running down from it to the hypogastric plexus (presacral nerves) are resected.

Other Operations on the Sympathetic in Special Cases.—

ANGINA PECTORIS.—Alcohol injections into the C 8 and D 1–6 nerves as they emerge from the vertebræ, in order to destroy the sympathetic fibres running from these nerves to the heart.

GASTRIC CRISES OF TABES.—Resection of or alcohol injections into the middle and lower intercostal nerves to destroy the sympathetic fibres going to the stomach.

CHAPTER XVIII.

AFFECTIONS OF MUSCLES, TENDONS,
SYNOVIAL SHEATHS, AND BURSÆ.

AFFECTIONS OF MUSCLES.

Traumatic Affections of the Muscles.—

RUPTURE OF MUSCLE SHEATH.—Especially in the biceps cubiti and rectus femoris. Causes soft hernia-like protrusion of muscle fibre when latter contracts. Rarely necessary to operate.

DISLOCATION OF TENDONS.—Most common in the neck, long tendon of biceps, peroneus longus. Great pain and stiffness after some sudden exertion.

TREATMENT is immobilization in plaster for 3 to 6 weeks in a position of complete muscular relaxation. Rarely (e.g., with peroneus) an open operation to suture the ruptured ligaments and tendon sheath is desirable.

RUPTURE OR DIVISION OF MUSCLES AND TENDONS.—

1. **CONTRACTION-RUPTURE.**—Voluntary, from an excessive or ill-balanced purposive movement, e.g., the rectus abdominis in labour. Involuntary, as in tetanus.
2. **TRAUMATIC.**—Contusions, e.g., the extensor tendons of the fingers by a sharp blow over the knuckles. Wounds dividing muscles and tendons.

POSITION OF RUPTURE.—(a) In muscle belly; (b) At junction of belly and tendon; (c) In tendon; (d) At insertion of tendon, where a piece of bone may be broken off.

MUSCLES COMMONLY AFFECTED.—Sternomastoid by traction during labour. Biceps cubiti (long head). Flexor tendons of the fingers and thumb by stab and incised wounds. Extensor tendons of the fingers by contusions. Muscles of the back and rectus abdominis by violent strains, tetanus, and parturition. Tendon of the adductor longus in riding. The quadriceps tendon or the ligamentum patellæ by contraction. The inner head of the gastrocnemius, the tendo Achillis, or the plantaris in athletic exercises (tennis leg).

SIGNS.—Sudden sharp pain. Snapping sound. Loss of function. Swelling and ecchymosis, with a palpable gap if the muscle belly is affected.

RESULTS.—Recovery if treatment is good and the muscle belly affected. Permanent disability if the tendons are divided and retract. Stiffness from adhesions of the tendons to the sheath. Weakness from the stretching of a fibrous scar.

TREATMENT.—In slight cases, immobilization in a position of extreme relaxation of the affected muscle.

In most cases, union by suturing. If the gap is very long:

- (a) Turning back from each end a tendon flap; (b) Grafting the distal tendon into a neighbouring tendon with similar function; (c) Filling the gap by strand of catgut or a piece of tendon taken from elsewhere.

Inflammation and Degeneration of Muscles.—

1. SIMPLE MYOSITIS, resulting from a wound or contusion.
2. RHEUMATIC MYOSITIS, causing pain and stiffness, e.g., stiff neck and lumbago.
3. ACUTE SUPPURATIVE MYOSITIS arises by infection in pyæmia. Results in considerable cicatricial deformity.
4. CHRONIC TUBERCULOUS MYOSITIS, secondary to bone disease, e.g., psoas abscess.
5. SYPHILITIC MYOSITIS from the formation of gummata, or fibroid thickening. Most often seen in the sternomastoid.
6. PARASITIC MYOSITIS—TRICHINOSIS.—

The adult *Trichina* worm lives in the alimentary canal of pigs, rats, and other usually carnivorous animals. It measures 1.5 mm. (male) to 3 mm. (female) long. Pigs become infected by eating dead rats, by being fed on offal, and from one another. The embryo worms work their way from the alimentary canal through the peritoneum to the muscles. The diaphragm, rib, and trunk muscles are most affected. When it reaches the muscle, the embryo becomes encysted between the fibres in an oval cyst 0.4 mm. long. In this condition its vitality is very resistant to heat, cold, or pickling.

CLINICALLY, the disease occurs in epidemics in Germany and America. Three stages are recognized: (a) A stage of enteritis with severe colic and diarrhoea, lasting about 10 days. (b) A febrile stage, temperature rising to 102–106° F., with severe muscular pains and swellings and some oedema; (c) A stage of subsidence, which occurs 6 weeks after infection. It is liable to be mistaken for enteric fever.

7. MYOSITIS OSSIFICANS.—

- a. TRAUMATIC.—A muscle, after injury, in the process of repair becomes ossified. It then forms a hard, sharply-defined mass. This is seen most often in the adductor longus, and is known as 'rider's bone'. A more diffuse type of myositis ossificans is seen in the brachialis anticus above the elbow and in the deep parts of the quadriceps above the knee in injuries of these parts. The ossification creeps into the muscle from torn periosteum. The condition is caused or aggravated by ill-advised forced

Myositis Ossificans—Traumatic, *continued*.

movements, especially in children, performed to prevent stiffness of an injured joint.

TREATMENT.—In the early stage the limb should be kept at rest. When mobility has to be restored, this should be done by slow and gradual extension or flexion without force.

In rare cases, and at a late stage when the disease is quiescent, improvement may be effected by dissecting out the plaques of bone from the deep muscle fibres.

- b. IDIOPATHIC.*—This affects many muscles, chiefly those of the back and trunk. It generally attacks young men, and is of slow and steady course, resulting in extensive ankylosis.

8. **MYOSITIS FIBROSA**, or the fibrous degeneration of muscles.

ISCHÆMIC PARALYSIS is the common name for this, which was first described as **VOLKMANN'S CONTRACTURE**.

CAUSES.—Pressure from within or without—e.g., effusion, displaced fragments, or tight splints—producing an interference with the vascular supply.

POSITION.—It has generally been observed in the forearm, and in the great majority of cases has followed fractures in the region of the elbow-joint.

PATHOLOGY.—There is a degeneration of the muscle fibres followed by a replacement fibrosis. Striation is lost.

SYMPTOMS.—Great swelling of the limb, with perhaps sloughing from pressure, occurs at the time, and within a few days the paralysis is noticed.

Flexion of the fingers at the phalangeal joints. These can only be extended when the wrist is flexed, showing that the flexor muscles are too short (*Fig. 40*).

Pronation of the hand is permanent from contraction of the pronator radii teres.

Some flexion of the elbow is caused by contraction of the flexor muscles which arise from the humerus.

Wasting is very marked, due to the atrophy of the muscles. The bones of the forearm are $\frac{1}{2}$ in. to 1 in. shorter than on the other side in cases where the condition has arisen in growing children.

Anæsthesia may be present, but has an irregular distribution; the hand is cold, the skin blue and shiny, but trophic ulceration is seldom seen.

Electrical reactions are generally merely diminished, but rarely the reaction of degeneration occurs. In this case, as in those showing anæsthesia and trophic lesions, the nerves have probably been affected as well as the muscles.

DIAGNOSIS must be made from :—

PRIMARY NERVE LESIONS, especially musculospiral paralysis. Here there is no flexor but an extensor lesion. In ulnar and median nerve lesions the paralysis is accompanied by anæsthesia, and both follow the anatomical distribution of the nerve. Reaction of degeneration is present.

INFANTILE PARALYSIS.—There is no local lesion. Reaction of degeneration is well marked, and contraction is much slower in its onset.

SYNOVITIS AND INJURY.—In this, matting and contraction of the tendons may occur. The fingers cannot be extended when the wrist is flexed.

PROGNOSIS.—Is bad in proportion to the extent and duration without treatment of the affection. If the condition is recognized early, the deformity can be prevented or removed by systematic exercises.

TREATMENT.—Massage with passive and active movements, continued daily for two years.

NON-OPERATIVE.—Flex the wrist fully, then strap each finger on to a straight gutter splint. After a few days, place the flexed wrist on a straight palmar splint and, by bandaging, stretch the flexor tendons.

OPERATIONS.—Cutting and lengthening the flexor tendons : a very difficult and tedious operation. Removal of a piece from the middle of the radius and ulna ; this is best done by oblique incisions, and the bones are then fixed to prevent fibrous union ; this shortening of the bones compensates the relative shortness of the flexor muscles. Sliding the origin of the common flexors from the internal epicondyle.

Tumours of Muscles.—

PRIMARY.—Sarcoma, fibroma. (Also gumma.)

Sarcoma is round- or spindle-celled. At first it forms a round encapsulated mass. But it grows rapidly and becomes diffused beyond the capsule. Wide excision or amputation is required. Any solid muscular swelling which grows steadily in spite of iodides should be regarded as sarcomatous.

SECONDARY.—Carcinoma or sarcoma.

DISEASES OF TENDON SHEATHS.

Tenosynovitis.—

1. ACUTE SIMPLE.—From strains and sprains. Commonest in extensor muscles of the thumb and peroneal of foot.

SIGNS : Pain, swelling, and fine crepitus when the tendon is moved.

TREATMENT—as for a sprain.

Tenosynovitis, continued.

2. ACUTE SEPTIC.—Caused by septic wounds or extension from neighbouring inflammatory foci. Constitutes the thecal variety of whitlow (*see* p. 32). Is apt to cause sloughing of the tendon and permanent adhesions.

TREAT by incisions and passive congestion.

3. SIMPLE CHRONIC.—Left after the acute attack, or caused by continuous over-strain. Increase of glairy effusion into the sheath, with swelling and weakness.

TREAT by counter-irritation and firm pressure. Rarely by puncture or incision.

4. CHRONIC TUBERCULOUS.—Common in the wrist and ankle. Two conditions may occur, separately or together:—

- a. Great swelling and hyperplasia of the synovial membrane, in which tuberculous granulations develop.

- b. Effusion of glairy fluid and deposit of fibrin in the form of 'melon-seed' bodies.

SIGNS are: chronic doughy swelling, with weakness and slight pain. May spread to the bones and joints, or suppurate.

TREAT by rest and pressure. If this fails, open and scrape out, rubbing in iodoform.

Ganglion.—A chronic synovial cyst, generally connected with a tendon sheath.

OCCURS generally at the back of wrist, connected with thumb or 1st finger extensor tendons. May occur on front of wrist or in the ankle region.

CAUSED BY a hernial protrusion of synovial membrane through the tendon sheath.

CONSISTS OF a firm, round, elastic, painless swelling over a tendon, filled with fluid or colloid.

TREATMENT.—(1) Subcutaneous rupture by pressure; (2) Puncture followed by pressure; (3) Excision.

COMPOUND PALMAR GANGLION is a tuberculous synovitis which affects the synovial membranes of the flexor tendons of the fingers and thumb under the anterior annular ligament. It forms a fluctuating swelling in the palm and above the wrist, which may extend up the thumb and little finger. It contains: (1) Tuberculous granulations growing from the synovial membranes; (2) Some free fluid; (3) Fibrinous melon-seed bodies.

TREATMENT by rest, and firm pressure with Scott's dressing; if this does not succeed, incision, scraping, and iodoform inunction. Permanent stiffness from tendon adhesions is likely to follow.

DISEASES OF BURSÆ.

Bursitis.—

1. ACUTE SIMPLE BURSTITIS.—From injury or irritation.

TREAT by rest and fomentations, and aspiration if necessary.

2. ACUTE SEPTIC BURSTITIS.—From septic wounds, or infection of a simple bursitis.

TREAT by incision and drainage.

3. CHRONIC SEROUS BURSTITIS.—The bursa is enlarged and distended by chronic effusion. Very common in the prepatellar bursa, forming the 'housemaid's knee'; over the acromion, 'the deal-runner's shoulder'; over the ischial tuberosity, the 'weaver's bottom'. It is caused by constant irritation and pressure. In the course of time the walls become thick and plastic or fibrous bursitis arises.

TREATMENT.—(1) Pressure and counter-irritation—this is likely to succeed only temporarily and in thin-walled recent cases; (2) Pressure after aspiration—recurrence is the rule; (3) Aspiration and injection of iodine—uncertain and painful; (4) Excision—the only satisfactory treatment in really chronic cases.

4. CHRONIC PLASTIC BURSTITIS.—Inside, the sac becomes thickened by fibrous tissue and nodular masses, some of which may form free bodies.

5. FIBROID BURSTITIS.—The sac becomes converted into a solid fibrous mass with small central cavity.

TREATMENT for this and No. 4 is only excision.

6. TUBERCULOUS BURSTITIS.—Similar to synovial tuberculous changes elsewhere. Usually leads to chronic suppuration.

TREAT by excision or scraping.

7. SYPHILITIC BURSTITIS.—Very rarely in the form of a symmetrical serous affection in the secondary stage. Common as a gummatous disease in the late stage, when it is apt to burst and cause the characteristic gyrate ulcers over the joint.

8. GOUTY BURSTITIS.—Very common over the big toe, frequent over the olecranon. Urate of soda forms a hard tophus which may lead to inflammation and discharge.

9. MALIGNANT BURSTITIS.—Rarely a bursa becomes the seat of a sarcomatous growth. This is manifested by the nodular character and rapid growth of the tumour.

FREE EXCISION OR AMPUTATION will be required.

Special Bursæ liable to disease.—

SUPRA-ACROMIAL.—The 'deal-runner's shoulder'.

SUBDELTOID, liable to be confused with shoulder-joint effusion (*see* Chap. XXIV).

SUBSCAPULAR, may communicate with the joint and be affected in tuberculous disease of the articulation.

SUPRA-OLECRANON.—'Miner's elbow'.

SUPRA-ISCHIAL.—The 'weaver's bottom'.

Bursitis—Special Bursæ, *continued*.

GLUTEAL BURSÆ.—(1) Between the osseous and fascial parts of the insertion of the gluteus maximus; (2) Between the great gluteal tendon and the great trochanter. Causes abduction of the hip.

SUB-PSOAS, generally bilateral, between the psoas tendon and the brim of the pelvis. May communicate with the joint. Causes flexion of hip, with pain on extension, other movements being free.

PATELLAR BURSÆ (*Fig. 41*).—These are four in number, though only one is commonly diseased:—

1. Suprapatellar. The bursa most commonly affected with all varieties of disease, constituting 'housemaid's knee'.
2. Subquadriceps. This usually communicates with the knee-joint and is affected with it.
3. Supraligamentous, over the patellar ligament.
4. Subligamentous, under the ligament, and may press into the joint itself.

SEMIMEMBRANOSUS (*Fig. 41*).—Between the inner head of origin of the gastrocnemius and the insertion of the semimembranosus. It is tense on extension and lax on flexion. It often communicates with the joint, and forms the commonest variety of 'Baker's cyst'.

SUBSARTORIAL.—Between the insertion of the sartorius and the inner tibial tuberosity, associated with the insertions of the semitendinosus and gracilis.

SUB-ACHILLES.—Forms swelling on either side of tendo Achillis.

ADVENTITIOUS BURSÆ.—Form over any normal or abnormal bony prominence. The commonest are over the vertebra prominens of the neck, between the hyoid bone and thyroid cartilage, the inner femoral condyle in genu valgum, the inner or outer sides of the foot in talipes valgus or varus, the metatarsophalangeal joint of the great toe in hallux valgus. The last is known as a BUNION.

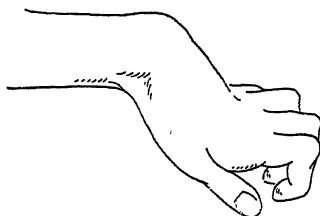


Fig. 40.—Ischaemic paralysis.

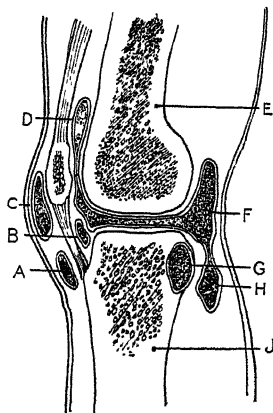


Fig. 41.—Diagram of the knee in longitudinal section, showing the position of various synovial cysts and bursæ. A, Bursa in front of ligamentum patellæ; B, Bursa behind ligamentum patellæ; C, Prepatellar bursa; D, Synovial pouch beneath quadriceps tendon; E, Femur; F, Posterior extension of synovial cavity; G, Bursa beneath semimembranosus tendon; H, Downward and backward extension of synovial cavity—i.e., a Baker's cyst; J, Tibia.

CHAPTER XIX.

DEFORMITIES.

Torticollis—Wry Neck (*Fig. 42*).—

ANATOMY. — Contraction of sternomastoid (constant); of trapezius, deep posterior cervical muscles, cervical fascia (often). Head inclines to affected side. Face turns to unaffected side. Atrophy of affected side of the face. Primary curve of cervical spine. Secondary curve of dorsal spine. Secondary shortening of ligaments and moulding of bones and joints.

VARIETIES.—

CONGENITAL.—Generally following difficult labour, producing kinking of vessels and nerves of sternomastoid. Microscopically identical with Volkman's contracture.

ACQUIRED.—

Rheumatic.—From myositis.

Spastic.—Clonic spasms of affected muscles; due to reflex or central irritation of cortical centres; young adults, generally women, with epileptic history.

Reflex.—Generally due to cervical caries.

Paralytic.—From paralysis (infantile generally) of the opposite muscles.

Neurotic.—In hysterical women.

DIAGNOSIS from CARIES OF SPINE (tenderness and pain on movement). DEEP ABSCESS of the neck. RHEUMATIC INFLAMMATION. By absence of pain, and tense band formed by the sternomastoid.

TREATMENT.—

SLIGHT CASES.—Massage, retentive apparatus.

CASES WITH WELL-MARKED CONTRACTURE.—Tenotomy of sternomastoid and fascia. Open incision across origin of sternomastoid. Free division of the muscle and any bands of fascia. Retention apparatus for a few weeks. Massage and exercises.

SPASTIC CASES.—First try general treatment.

Operation: Excision of parts of spinal accessory of affected side, and posterior primary divisions of upper three cervical nerves on the opposite side.

Cervical Rib.—See p. 169.

Scoliosis.—Lateral curvature of the spine, with rotation of vertebræ.

CAUSES.—

CONGENITAL.—From presence of a half vertebra.

RICKETS.—Early or late.

STATIC CAUSES (to compensate for another deformity).—Torticollis—Empyema—Hip disease or dislocation—Any shortening of the lower limb.

ADOLESCENCE.—Anæmia and asthenia during rapid growth. Muscles and ligaments stretch. Especially in occupations with much standing, lifting, or carrying.

ANATOMY.—

VERTICAL CURVES.—Usually main curve with convexity to the right occupying the dorsal region. Secondary curve to the left in lumbar region.

ROTATION.—Due to greater displacement of bodies than of the laminae of the vertebrae.

Bodies will be directed to the convexity, spines to the concavity of the curve.

The ribs will project on the right side posteriorly, and be flattened on the opposite.

The ribs will project on the left side anteriorly.

The sternum remains in the mid-line, but is twisted to the right. Right shoulder projects behind and is raised ('shoulder grows out').

Left hip appears more prominent.

SECONDARY CHANGES.—Vertebrae and discs become shorter, and the ligaments and muscles are shortened, on the side of the concavity. Joints become ankylosed.

STAGES OF THE DEFORMITY.—

1. The deformity can be rectified by the patient's own muscular effort.
2. Can be rectified when the spine is flexed, or by manipulation, e.g., suspension.
3. Deformity becomes fixed by the shortening of muscles and ligaments and by ankylosis.

DIAGNOSIS.—Primary deformities or diseases of shoulder, breast, or hip must be distinguished from similar deformities secondary to scoliosis.

PROGNOSIS depends on the stage the deformity has reached.

When it can be reduced by manipulation the prognosis is good.

When it cannot be altered it cannot be cured but may be arrested.

TREATMENT.—Remove the cause in static cases. Treat general conditions, e.g., rickets or anæmia.

IN ADOLESCENT CASES:—

Rest on an inclined plane.

Massage and cold douches.

Voluntary 'redressement': correcting deformity in front of a mirror.

Exercises: Flexion and extension of the back when standing. Horizontal bar exercises. Flexion and extension of the back when lying face down at the end of a table.

Scoliosis—Treatment, *continued*.

Carefully applied spinal support. This is not an absolutely rigid jacket, but a steel support which allows some spinal movement, and by the pressure of pads and springs tends to correct the deformity.

ABBOTT'S TREATMENT.—The patient is slung in a kind of canvas hammock which allows the spine to lie in a flexed position. Bands are passed round the trunk in such a manner that traction on these reduces the deformity, both lateral and rotatory. In this partly corrected position a plaster jacket is applied. Windows are cut in the jacket, and through these pads are inserted from time to time, so as further to press upon the convexity of the curves. After a few months the jacket is renewed and a further degree of correction obtained.

Kyphosis.—Abnormal backward curve of the spine. Usually limited to the dorsal region, unless it follows organic spinal disease. There are three groups of cases:—

1. **DEFECTIVE GROWTH OR HABIT.**—Rickets in children—Adolescence—Occupations which necessitate stooping—Senile atrophy of muscles of the back.
2. **FROM GENERAL DISEASE** of the spine and its muscles, etc.—Osteo-arthritis—Osteitis deformans—Osteomalacia—Acromegaly—Pulmonary osteo-arthropathy.
3. **FROM LOCAL SPINAL DISEASE.**—Fractures—Pott's disease—New growths.

TREATMENT (in the first group only).—

Remove the cause, if possible (e.g., myopia and any stooping habit).

Massage, electricity, and exercises for the back.

Recumbency on a hard, flat mattress or board.

Chance's splint: this consists of two steel bars fixed to a pelvic girdle and lying by the side of the vertebral column. To these are fixed adjustable padded plates which exert constant pressure on the protuberant parts of the spine and ribs, without preventing mobility.

Lordosis.—An abnormal forward curve of the spine, usually in the lumbar region.

It is always secondary to: (1) Diseases of the hip or of the psoas muscle. (2) A primary kyphotic curve above. (3) Any abnormal growth which places the centre of gravity forwards, e.g., pregnancy.

Spondylolisthesis.—Forward and downward slipping of lumbar vertebrae from top of sacrum.

Deformities of the Upper Extremity.

SPRENGEL'S SHOULDER.—Congenital deformity. The vertebral border of the scapula is raised, the serratus and trapezius muscles are ill-developed.

CLUB-HAND.—Usually associated with congenital absence of the radius.

MADELUNG'S DEFORMITY OF THE WRIST.—Lower end of ulna projects upon dorsum of wrist. Styloid of radius is higher than that of ulna. The hand is adducted, and in most cases displaced forwards (rarely backwards). It occurs at the ages of 8-18, and is much commoner in girls than boys. It is probably due to a partial arrest of development in the radial epiphysis. Treatment consists in a cuneiform osteotomy of the radius performed when growth has ceased.

POLYDACTYLISM.—Supernumerary fingers or toes: usually only affects the phalanges.

ECTRODACTYLISM.—Absence of one or more digits.

MACRODACTYLISM.—Overgrowth of one or more digits.

SYNDACTYLISM.—Fusion of adjacent digits, either complete or only at their bases—the so-called webbed fingers or toes. The same condition may be acquired after burns.

TREAT by a plastic operation.

CONGENITAL CONTRACTION OF THE FINGERS.—Usually of the little finger only. The last two phalanges are flexed, the first hyperextended. The central digital prolongation of palmar fascia is contracted.

TREAT by the division of this band.

SPRING OR SNAP-FINGER.—Development of a sesamoid bone in the flexor tendon, which catches under the tendon sheath opposite the metacarpo-phalangeal joint.

MALLET OR HAMMER-FINGER.—Flexion of the terminal phalanx. Acquired deformity from rupture of the extensor aponeurosis.

TREAT by a palmar splint or suture of the tendon.

DUPUYTREN'S CONTRACTION.—An acquired flexion of the fingers.

Usually in GOUTY men; often SYMMETRICAL, often HEREDITARY. CONSTANT PRESSURE on the palm by an instrument may cause it.

Affects the ring or little finger first, the former more often than the latter; the others later.

The flexion is of the first and second phalanges, the third is extended.

An indurated nodule forms in the palmar fascia.

Consists of a contraction of the palmar fascia and its lateral prolongations into the digits.

DIAGNOSIS from congenital contraction (above) and contraction of the flexor tendons, which are relaxed on flexing the wrist.

TREATMENT by incision or excision of the contracted bands. Excision of the base of the proximal phalanx, thus shortening the finger.

Congenital Dislocation of Hip.—See Chap. XXIII.

Coxa Vara.—Deformity of the hip-joint due to a lessening of the angle between the neck and shaft of the femur (*Fig. 43*).

The angle is normally about 125° ; at birth it is much more open (160°), and continues to diminish until growth is complete at 18–20. In late life atrophy of the neck may lead to further closing of the angle.

CAUSES AND VARIETIES.—

RICKETS.—In young children. Bilateral. Very rare.

ADOLESCENCE.—The common form. The normal closure of the angle of the neck of the femur is carried too far.

Carrying heavy weights and late rickets may also be concerned in this form.

SLIPPING OF THE EPIPHYSIS.—Accounts for cases coming on after an injury. The deformity is marked and unilateral.

SENILE FORM.—Atrophy of the neck makes the bone yield. Usually associated with osteo-arthritis.

ANATOMY.—The angle between the neck and shaft is reduced to a right or even an acute angle. The neck of the bone is shorter than normal. The margins of the head are overgrown. The back of the femoral neck is more absorbed than the front, so that the shaft is everted.

SYMPTOMS.—

Aching and tiredness, with marked limp. Shortening of the leg, the trochanter rising above its normal position and becoming very prominent. Eversion of the leg at the hip-joint. Adduction very marked, especially on flexing the thigh. Scissor-leg deformity if both sides are affected. Abduction and internal rotation are very limited. Other movements of the hip are free and painless. There is a marked absence of tenderness on pressure.

DIAGNOSIS.—From: Tuberculous disease of hip (*q.v.*)—Congenital dislocation (*q.v.*)—Mal-united fracture.

TREATMENT.—

REST IN THE EARLY STAGES when the deformity is still in progress.

SUBTROCHANTERIC OSTEOTOMY, after growth has ceased. The limb should be put up in an abducted position. Later a tilting of the pelvis will make up for much of the shortening.

Coxa Valga.—A rare condition. The opposite to vara, i.e., the femoral angle is more widely opened, and varies from 130° upwards to 180° .

CAUSES.—

CONGENITAL.—Frequently found in congenital hip disease. It may be the cause or result of the dislocation.

ACQUIRED.—Any hanging limb (e.g., paralysis) or stump will acquire a straight-necked femur. Infantile paralysis, scoliosis,

or other static causes. Mal-union after fractures. Rickets (very rare).

May be unilateral or bilateral. In the latter case it is probably a slight degree of congenital dislocation.

SYMPTOMS AND SIGNS.—

Limping towards the affected side: the gait is rolling in bilateral cases. Lengthening of the limb by 2–3 cm.

Abduction and external rotation of the leg, whilst adduction is limited. Region of the trochanter is flat, and the trochanter is below Nélaton's line. Skiagram shows the straight neck.

TREATMENT.—By subtrochanteric or cervical osteotomy.

Genu Valgum—Knock-knee.—

CAUSES.—

RICKETS, the common cause in young children.

STATIC CAUSES, i.e., long standing in a rapidly-growing patient whose ligaments are soft and relaxed.

TRAUMATIC CONDITIONS which interfere with the position or growth of the condyles or tibial tuberosities.

ANATOMY.—One or more of three bony changes have occurred:—

1. The lower end of the femur is bent outwards.

2. The upper end of the tibia is bent inwards.

These two conditions are most common in rickets.

3. The internal condyle of the femur and internal tuberosity of the tibia are developed disproportionately to the external parts. The common condition in adolescents.

The internal lateral ligament is relaxed, and in many cases the internal tibial tuberosity can be separated from the femur by forcible abduction.

The external lateral ligament, iliotibial band, and biceps tendon are proportionately shortened.

The patella is displaced towards the outer side of the knee.

PATHOLOGY.—In standing, especially with the feet apart, the line of the tibia lies outside that of the femur, the internal lateral ligament of the knee is relaxed, the external half of the joint is pressed together, the internal half is pulled apart. Hence the internal ligament stretches and the internal parts of the joint grow faster than the external.

SIGNS.—When the knees are extended and touching each other the feet are widely separated.

With very slight flexion of the knees the ankles come together in the majority of cases. This is due to the fact that flexion is always accompanied by some internal rotation which swings the feet round towards one another.

The toes point outwards when standing. This is due to an exaggerated external rotation.



Fig. 42.—Torticollis. Left sternomastoid is contracted. Head bent to the left, chin turned to the right. Note the asymmetry of the face.

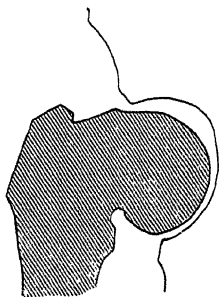


Fig. 43.—Coxa vara. The angle between the neck and shaft of the femur is reduced to a right angle.



Fig. 44.—Talipes equinus.



Fig. 45.—Congenital talipes equinovarus.



Fig. 46.—Talipes calcaneus.

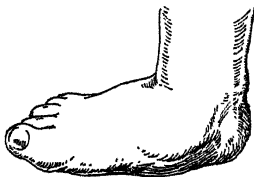


Fig. 47.—Talipes valgus.

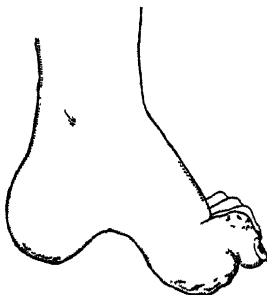


Fig. 48.—Pes cavus.

When walking the knees are kept slightly flexed, so as to minimize the deformity, which, as above explained, tends to disappear on flexion.

A bursa often forms over the inner sides of the knees when they knock together.

It is usually bilateral. Rarely it may be unilateral, or one knee may be in genu valgum and the other genu varum.

COMPLICATIONS.—Scoliosis or flat-foot often co-exists with genu valgum. The pelvis is tilted in unilateral cases.

TREATMENT.—

1. **REST WITH SPLINTS.**—In all rickety cases—In all patients below the age of puberty—In unhealthy patients when the condition is progressing.

Young children should be kept off the ground, either in bed or by application of splints extending beyond the feet.

Long outside splints should be re-applied daily, with massage night and morning.

Starch bandages should be used only to fix the splints for one or two weeks at a time at first, to get the child used to them, or in cases where no one can be trusted to re-apply them.

Iron splints fixed into the boots, with straps to fasten above and below the knee, for adolescent cases.

2. **SPECIAL BOOTS.**—In all ambulant cases, or those in pre-operative stages, the boots should be well raised on the inner sides so as to invert the feet and take the strain off the internal lateral ligaments of the knees.

3. **OPERATION.**—For all cases in which growth has ceased and in which the deformity is permanent.

a. **OSTEOTOMY OF THE SHAFT OF THE FEMUR** (Macewen's operation).—The bone is partly cut and partly broken just above the condyles. The limb is put up in a rectified position.

This is the easiest and best operation in most cases.

b. **CUNEIFORM OSTEOTOMY OF THE TIBIA.**—A wedge-shaped piece is cut out from the shaft of the tibia on its inner side below the tubercle.

This is probably the most accurate method, but it requires some precision.

Genu Varum—Bow Legs.—Is similar, but opposite to the above. All the changes on the inner side of the joint above described are here external, and *vice versa*. It is much rarer than genu valgum. It seldom requires treatment, as it causes less inconvenience.

TREATMENT when required is on the same lines as the above, femoral osteotomy being the operation of choice.

TALIPES (CLUB-FOOT).**Causes.—**

CONGENITAL.—Often hereditary. Malposition in utero. Reversion to a simian type.

ACQUIRED.—

NERVE DISEASE.—Anterior poliomyelitis. Cerebral and spinal sclerosis, producing spastic paralysis. Lesions of peripheral nerves.

MUSCULAR DISEASE.—Suppuration and contraction in muscles and fasciæ.

BONE INJURIES.—Fracture and dislocations with bad union about the ankle.

COMPENSATORY to other deformity.

STATIC CAUSES.—Prolonged standing—Decubitus.

Varieties.—

TALIPES EQUINUS.—Hyperextension of ankle. Walks on the toes.

TALIPES CALCANEUS.—Flexion of the ankle. Walks on the heel.

TALIPES VARUS.—Adduction of the foot at midtarsal joint. Inner margin of the sole raised. Walks on outer side of foot.

TALIPES VALGUS.—Abduction of the foot at midtarsal joint. Outer margin of the sole raised. Walks on inner side of the foot.

TALIPES EQUINO-VARUS, CALCaneo-VALGUS.—The commonest combinations of the above.

TALIPES EQUINO-VALGUS, CALCaneo-VARUS.—Rare.

General Features of Congenital Talipes.—Exists from birth.

Often bilateral. Is associated with primary malformation of bones and ligaments and contraction of muscles. Except in early infancy the deformity cannot be corrected by simple manipulation. No wasting or spasm of muscles. No trophic changes or defects in the circulation. Electrical reactions of the muscles are unaltered. Growth of the limb is not impaired. Furrows are formed in the flexures of the foot.

TREATMENT.—

IN INFANCY.—Daily manipulation, massage, and bandaging.

AFTER THE CHILD HAS BEGUN TO WALK.—The foot is wrenched into over-corrected position and put up in plaster for some weeks. A metal brace is worn for a time until the child can be taught to walk correctly.

IN CHILDHOOD when deformity cannot be improved by manipulation.—Tenotomy of contracted muscles. Fixing in corrected position by plaster. Massage and passive movements. Osteotomy.

IN ADULT CASES.—Some form of osteotomy.

General Features of Paralytic Talipes.—Begins in second or third year with infantile paralysis. Seldom bilateral. Limb is cold, blue, and clammy. Muscles are much wasted and

paralysed. Electrical reaction absent in paralysed muscles. General growth of the bones diminished. The limb is flabby, and can easily be restored to the correct position until late contractions have developed. Furrows do not form in the flexures.

TREATMENT.—

IN EARLY STAGES.—Flexner's serum intrathecally over the area corresponding to the paralysed limbs. Limbs put in light splints to maintain the correct position. Complete rest until all pain has gone—usually about six weeks; then massage and electrical treatment. Re-education in movements. Splints to correct attitude—i.e., paralysed muscles must be relaxed.

IN CASES WHERE NO FURTHER MUSCULAR RECOVERY IS POSSIBLE.—

Where Deformity has not been Prevented:—

Tenotomy of muscles opposed to the paralysed groups.

Grafting parts of unparalysed tendons into those which are paralysed.

Where all the Muscles are Paralysed, and in many of the above cases as a sequel to the other methods:—

A boot with irons and springs.

Or an *excision*, with fixation, of a flail joint or one in bad position.

General Features of Spastic Talipes.—The symptoms of spinal sclerosis or cerebral disease are present. The deformity can be reduced by manipulation, except in very old cases. Exaggerated knee-jerks and ankle clonus. Muscles do not atrophy till late.

TREATMENT.—Re-education of muscles. Some retentive apparatus. Massage and electrical treatment strictly contra-indicated.

Talipes Equinus.—

CAUSES.—Nearly always acquired. Infantile paralysis of anterior tibial muscles. Partial paralysis of all leg muscles, the calf muscles overcoming the anterior. Spastic contraction of the calf muscles. Compensatory to any shortening of the leg. From pressure of the bedclothes.

SIGNS.—Three degrees of extension of the ankle:—

1. Foot cannot be flexed beyond a right angle. Thus the toes catch the ground in walking.
2. The heel cannot be brought to the ground. Patient walks on the balls of the toes (*Fig. 44*).
3. Foot is in a line with leg or a little behind it. Toes are doubled under the foot, and patient walks on their dorsal surfaces.

Pes cavus is often present from a flexion of the sole at the mid-tarsal joint, especially in paralytic cases.

TREATMENT.—Tenotomy of the tendo Achillis. Plaster-of Paris in over-corrected position.

Talipes Equinus—Treatment, continued.

IN PARALYTIC CASES.—Grafting half tendo Achillis into the tibialis anticus, and the peroneus longus into extensor tendon. A boot with a toe-raising spring.

COMPENSATORY TALIPES EQUINUS should not be treated unless the primary condition is cured.

Talipes Equinovarus.—**CAUSES.—**

CONGENITAL.—Represents a reversion to a simian type. In infants the head and neck of the astragalus form an angle of 35° inwards with the body. If this persists or is exaggerated, adduction of the foot with varus results.

ACQUIRED.—Paralysis of extensor and peroneal muscles. Tibialis anticus may escape or not. Over-action of calf muscles and tibialis posticus, and sometimes of tibialis anticus. Injury of the external popliteal nerve (*see* p. 175).

SIGNS.—Heel cannot be brought down to the ground. Foot is adducted at the mid-tarsal joint. Patient walks on the outer margin of the sole (*Fig. 45*). A transverse furrow crosses the sole at the mid-tarsal joint, and a longitudinal furrow runs along the sole in congenital cases. A callosity or bursa is formed over the cuboid. A secondary contraction occurs of plantar fascia.

ANATOMY.—

ASTRAGALUS is misshaped. The head is set at an angle of 50° with the body. It is displaced forwards and inwards from the ankle-joint.

SCAPHOID is on the inner side of the astragalus and almost touches the internal malleolus.

THE LIGAMENTS on the sole and inner side of ankle are contracted, viz.: Internal lateral ligament, inferior calcaneo-scaphoid ligament, plantar fascia.

THE FOLLOWING MUSCLES ARE CONTRACTED: Tibialis posticus, tibialis anticus, flexor longus hallucis, flexor longus digitorum, abductor hallucis, tendo Achillis.

TREATMENT.—

IN SLIGHT OR EARLY CASES.—Massage, manipulation, and bandages. Malleable splints.

IN CASES WHERE CONTRACTION OF THE MUSCLES AND LIGAMENTS HAS OCCURRED.—

1. Tenotomy of tibialis posticus and anticus. Division of internal lateral ligament in its anterior part. Division of the plantar fascia and spring ligament.

All these may be divided by a single open incision. This is Phelps's operation.

Subsequent tenotomy of tendo Achillis.

2. Removal of the whole or anterior part of the astragalus and the anterior part of the os calcis, with shortening of the peroneal tendons. Although this sounds formidable, it is probably the best treatment in all bad cases in patients over two years.

IN CASES OF OLD STANDING, WHERE ANKYLOSIS AND BONY CHANGE ARE MARKED, or where other measures have failed.
—Excision of astragalus, or wedge-shaped tarsectomy from the outer side of foot.

IN PARALYTIC CASES.—After correcting the deformity by tenotomies, graft half the tendo Achillis into the peroneus longus, and the tibialis anticus into the peroneus brevis.

Talipes Calcaneus.—May be either congenital or paralytic. Sometimes follows a too free tenotomy of the tendo Achillis. The patient walks on his heel (*Fig. 46*), the gait is heavy and stamping. The extensor tendons are contracted. The tendo Achillis is stretched or the posterior muscles are paralysed.

TREATMENT.—

IN CONGENITAL CASES.—Tenotomy of the extensor tendons.

IN PARALYTIC CASES.—Grafting peroneus longus tendon into tendo Achillis. Boot with a toe-depressing spring.

IN TRAUMATIC CASES.—Shortening of the tendo Achillis, or transplanting the tuberosity of the os calcis lower down.

Talipes Valgus.—Rare except in conjunction with flat-foot. May be congenital or paralytic. There is abduction of the foot at the mid-tarsal joint and an eversion of the sole of the foot (*Fig. 47*). The peronei muscles are contracted in congenital cases. The tibial and some of the extensors are paralysed in paralytic cases.

TREATMENT.—Division of the peronei tendons in congenital cases. Grafting of part of the tendo Achillis into the tibialis posticus in paralytic.

Flat-Foot—Pes Planus.—In a simple form consists in a mere loss or flattening of the arches of the foot, but it is nearly always combined with some degree of valgus, i.e., of abduction and eversion of the front part of the foot.

CAUSES.—

STATIC CONDITIONS.—Long standing in growing persons.

CONGENITAL CONDITIONS.—Very long feet.

PARALYTIC.—Paralysis of the tibials and extensor muscles.

INFLAMMATORY.—Rheumatic or gonorrhœal affections of the foot rapidly soften ligaments, and arches of foot give way.

TRAUMATIC.—After Pott's fracture, or severe sprains or injuries of the ankle, there is a great tendency for flat-foot to be left.

Flat-Foot, continued.

ANATOMY.—

1. THE LONGITUDINAL ARCH of the foot is flattened. The muscles, ligaments, and tendons in the sole are stretched, viz.: the inferior calcaneoscaphoid or spring ligament, the calcaneocuboid ligaments (plantar ligaments), the tendons of the tibialis posticus and anticus, the flexores longi digitorum and hallucis, with the short muscles.
The giving way of the calcaneoscaphoid ligament allows the astragalus to drop, so that it may actually touch the ground.
2. THE TRANSVERSE ARCH is flattened, the foot being broader than normal.
3. ABDUCTION OF THE FOOT, chiefly at the mid-tarsal joint. The astragaloscaphoid joint projects prominently on the inner side of the sole.
4. EVERSION OF THE SOLE OF THE FOOT.—This also takes place at the mid-tarsal joint. The inner margin of the sole is depressed, the outer raised. The peronei tendons are tense and rigid.
5. EVENTUALLY, in old, neglected, and inflammatory cases, the bones become distorted by osteophytic outgrowths, and the joints, especially the astragaloscaphoid, obliterated by ankylosis.

SYMPTOMS.—Walk is shuffling or waddling. The toes are turned outwards (splay-feet). The heels do not leave the ground before the toes. The whole sole comes into contact with the floor. All power of jumping or dancing or raising the body on the toes is lost or diminished. Aching pain on the sole of the foot over the mid-tarsal joint is present, much worse on standing or walking.

DEGREES OF MUSCULAR AND ARTICULAR CHANGE.—

1. A MERE LOSS OF STRENGTH AND TONE IN THE MUSCLES, the ligaments being stretched. The patients can rectify the deformity to a great extent when they place their toes together and stand on tiptoe. The deformity can be easily rectified by passive movements.
2. ACTUAL PARALYSIS OR FUNCTIONAL INCAPACITY of the muscles, with contraction of the peronei. The patient cannot stand on his toes, or in any way restore the arch of his foot. Passive movements will, however, rectify this deformity.
3. ADHESIONS AND CONTRACTIONS fix the deformity so that neither active nor passive movements have any effect on it.
4. ACTUAL BONY DEFORMITY AND ANKYLOSIS render the condition permanent.

TREATMENT.—

1. FOR THE FIRST DEGREE.—Massage, with tip-toe exercises. Boots with stiffening on the inner side of the uppers and thickened inner border to the sole.
2. FOR THE SECOND DEGREE.—In addition to the above, Whitman's metal spring and a boot with an outside leg iron with a valgus T-strap.
3. FOR THE THIRD DEGREE, especially in inflammatory cases.—Tenotomy of the peronei (where necessary). Wrenching the foot into good position under an anæsthetic. Fixing in a corrected position in plaster-of-Paris. A boot with a leg-iron must be worn for some time.
4. FOR THE FOURTH DEGREE.—Some form of tarsectomy. Removal of a wedge-shaped piece from the inner border of the sole. Removal of parts of the astragalus or scaphoid, or both.

Pes Cavus, or Claw-foot.—The longitudinal arch of the foot is exaggerated (*Fig. 48*). There is some degree of hammer-toes. It usually accompanies a slight degree of talipes equinus. There is more or less pain and disability on walking.

TREATMENT.—Tenotomy of the tendo Achillis (in equinus cases). Fasciotomy of the plantar fascia. Boot should have a low heel and be provided with a transverse bar below and behind the heads of the metatarsal bones.

TRANSPLANTATION OF TENDON of the extensor proprius hallucis. This tendon is cut near to its insertion, and is passed through a hole in the neck of the 1st metatarsal bone, thus raising the dropped metatarsal.

In severe grades where all the toes are hammer and there is some equinovarus. In these cases, in addition to fasciotomy and tenotomy of the tendo Achillis, the astragalus should be removed, and, in the most extreme cases, also the toes with the heads of the metatarsal bones.

Hallux Valgus.—Abduction of the phalanges with adduction of the metatarsal of the great toe. It is often associated with flat-foot, the transverse arch being flattened and the first metatarsal turned inwards. Is often caused by pointed-toed boots. The metatarsophalangeal joint becomes very prominent, and is usually affected with hypertrophic osteo-arthritis. A marked bunion, i.e., a chronically inflamed bursa, forms over the prominent joint. The toes are crowded together, hammer-toe often co-existing in the other toes.

TREATMENT.—A straight inner-edged boot with a toe-post from the sole to keep the toe in position, for early cases.

A spring along the inner side of the foot drawing the great toe inwards by a band.

Excision of the joint and the bunion is the best treatment of most cases.

Hallux Valgus—Treatment, continued.

A flap of fascia is prepared from the inner aspect of the toe and is fixed over the neck of the metatarsal bone after excision of its head.

The external metatarsal condyle may be separated, and then slid back and pegged, after cutting the internal lateral ligament.

Hallux Rigidus or Flexus.—A flexion of the first phalanx on the metatarsal of the great toe. The joint is affected by osteoarthritis. It often accompanies flat-foot.

TREATMENT is first that of the flat-foot, and then if necessary an excision of the head of the metatarsal bone.

Hammer-toe.—Hyperextension of the first phalanx, with flexion of the other phalanges. The first interphalangeal joint forms an upward projection. The point of the toe is on the ground. Corns or bursæ are formed under the head of the metatarsal bone and the point of the toe, and over the interphalangeal joint. The second toe is most frequently affected. The extensor tendons stand out very prominently.

CAUSES.—Sometimes congenital. Secondary to talipes equinus and pes cavus, or hallux valgus. Paralysis of the interossei and lumbricales (?). Short boots with high heels and pointed toes.

ANATOMY.—Partial dislocation of the second phalanx downwards. Marked shortening of the lateral digital bands of plantar fascia and of the lateral ligaments of this joint.

TREATMENT.—Excision of the head of the first phalanx.

A plantar splint to which the toe is bound down may be used in slight cases or after operation.

Metatarsalgia, or Morton's Disease.—Pain at the heads of the metatarsal bones. Probably a variety of flat-foot affecting chiefly the transverse arch. Possibly a direct pressure on the digital nerves results. It occurs specially in gouty or rheumatic subjects. The foot is broader than normal, and corns form on the sole beneath the heads of the metatarsal bones.

TREATMENT.—Rest and massage. Support by some kind of a valgus pad (*Fig. 49*) or brace.

In severe cases, a ligature round the necks of the metatarsal bones, bracing them together.

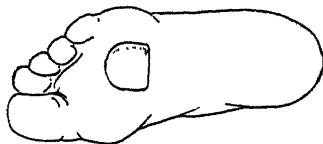


Fig. 49.—Pad for splayed foot.

CHAPTER XX.

FRACTURES.

Predisposing Causes.—

AGE, SEX, AND OCCUPATION.—

Young children, in whom ossification is incomplete, and who are constantly falling.

Old people, in whom some atrophy of the bone takes place.

Labouring classes, athletes, etc., because of the activity of their occupation.

Male sex. Except lower end of radius and head of femur.

MORBID BONE CONDITIONS.—

GENERAL.—Atrophy: senile, disuse, paralysis—Fragilitas—Rickets—Osteomalacia.

NERVE DISEASES.—Tabes, syringomyelia, general paralysis.

LOCAL BONE DISEASES.—Sarcoma—Carcinoma—Myeloma—Gumma—Caries or necrosis: septic, tuberculous, syphilitic—Fibrocystic disease.

Exciting Causes.—

DIRECT VIOLENCE.—Transverse in direction. Little displacement. Often compound or comminuted.

INDIRECT VIOLENCE.—Oblique or spiral in direction. Great displacement.

MUSCULAR ACTION.—Patella and olecranon, common. Other bones, rare.

Spontaneous Fractures.—Cases where the exciting cause is trivial and fracture determined by a pre-existing morbid bone condition. These are:

1. FRAGILITAS OSSIIUM.—The commonest cause in children. An imperfection in the ossification, the only symptom of which is the liability to fractures. It manifests itself in children, who lose the tendency in adult life. It may occur in new-born children, where the fractures are usually multiple. Union is rapid and normal.
2. NERVE CONDITIONS.—Tabes, syringomyelia, general paralysis. Tabes is the commonest cause in adults. There is no demonstrable change in the bone; possibly the ataxia may be concerned in it. The fracture is remarkably painless. It unites rapidly if properly immobilized, but there is an exuberant callus formation.
3. ATROPHY.—The common cause in old people. May be senile or due to disuse or paralysis. The hard bone is replaced by fat-containing cancellous tissue.

Spontaneous Fractures—Predisposing Causes, *continued*.

4. **OSTEOMALACIA.**—Usually attacks women, and is then associated with pregnancy. The tendency to fractures is associated with a softening and bending of the bones.
5. **FETAL AND SCURVY RICKETS.**—Usually occurs at the epiphyseal junction in scurvy, and in the shafts of the long bones in foetal rickets.
6. **INFLAMMATORY BONE DISEASES,** whether they produce caries or necrosis. Tubercle (commonly), septic and syphilitic disease (both rarely).
7. **TUMOURS OF BONE.**—
 - a. Sarcoma, usually primary, may be medullary or periosteal. The fracture will not unite.
 - b. Carcinoma—always secondary. The fracture usually unites if it is immobilized.
 - c. Myeloma—often associated with albumosuria.
 - d. Gumma.
 - e. Fibrocystic disease.
 - f. Cysts, simple or hydatid.

Varieties of Fracture.—

CLOSED (simple).—No communication with a wound.

OPEN (compound).—Fracture communicates with a wound.

INCOMPLETE FRACTURE.—Bone not broken through.

GREENSTICK.—Occurs in children, especially with rickets.

Concavity of long bone is bent. Convexity is splintered.

FISSURES of long bones, especially near joints.

CRUSHING of outer table of bones: Occurs in skull—Small cancellous bones.

COMPLETE FRACTURES may be:—

TRANSVERSE, especially when caused by direct violence.

OBLIQUE, especially when caused by indirect violence.

SPIRAL, especially when caused by rotation.

COMMUNUTED, when bone is broken into more than two pieces.

IMPACTED, when one fragment is driven into another.

COMPLICATED, when combined with an injury of another important structure, e.g., artery or joint.

SEPARATION OF EPIPHYSES.—Common in patients under twenty. May occur up to twenty-five.

CAUSES.—Joint injuries which produce dislocation in older patients. Syphilis in infants. Tubercle. Infective osteomyelitis.

ANATOMY.—Fracture runs through diaphysial side of the ossifying cartilage. Fractured surface of the epiphysis is concave. The older the patient, the more likely is it to involve the shaft as well as the epiphysial line. Periosteum closely attached to epiphysis is stripped off shaft. Shaft may be thrust through the periosteal sleeve.

RESULTS.—(1) Recovery as in fracture, if apposition is good ;
 (2) Retarded length of a long bone—deformity of wrist or ankle resulting from this ; (3) Suppuration, with death of epiphysis ; or (4) Arthritis from extension to joint.

EPIPHYSES AFFECTED, in order of frequency :—

Upper and lower ends of humerus, lower end of radius, lower end of femur, about equal.

Upper end of femur, upper end of tibia, tibial tubercle alone, great trochanter, rare.

Signs of Fracture.—

1. WOUND, CONTUSION, OR BRUISING.
2. UNNATURAL MOBILITY in the shaft of long bone.
3. CREPITUS on movement.
 MAY BE SIMULATED by : Osteo-arthritis — Tenosynovitis — Surgical emphysema.
 MAY BE ABSENT in : Fracture with impaction—Separated epiphysis—Wide separation of fragments—Interposition of soft parts—Partial fracture (greenstick).
4. DEFORMITY or displacement.
 CAUSED BY : (a) Violence ; (b) Weight of limb ; (c) Muscular action ; (d) Manipulation.
 VARIETIES.—Angular—Longitudinal overlapping or divarication —Lateral—Rotatory—Depression.
 EVIDENCES OF DISPLACEMENT.—Altered line of the bone—Altered measurement (generally shortened)—Altered relation of neighbouring bony points.
5. PAIN and loss of function.
6. SKIAGRAM showing fissure or fracture.

Symptoms following Fractures.—

Shock, slight in uncomplicated cases.

Febrile reaction. Temperature 100° to 101° F. on second and third days. In proportion to ecchymosis.

Rare Symptoms.—

Delirium tremens in drinkers.

Fat embolism : Dyspnoea — Syncope — Coma (from blocking of capillaries of lungs and brain with fat globules).

Complications of a Fracture.—May cause :—

1. INFECTION : Non-union, necrosis, or deformity.
2. JOINT INVOLVEMENT : Arthritis and adhesions.
3. DISLOCATION.
4. INJURY TO MAIN ARTERY : Aneurysm or gangrene.
5. INJURIES OF VEINS : Ecchymosis and œdema.
6. INJURIES OF NERVES : Rupture or involvement in callus.
7. INJURY TO VISCUS.

Repair of Fractures.—**FIRST WEEK.—**

BLOOD-CLOT forms round the broken ends and beneath the torn periosteum. Soft parts become swollen and œdematous.

SECOND WEEK.—

GRANULATION TISSUE replaces the clot. This is complete about the tenth day, when the fracture is fixed in a mass of granulation.

CALCIFICATION of the granulation tissue to form callus.

Medullary tissue is also absorbed and replaced by callus.

The ends of the bone become porous.

CALLUS is situated :—

1. Between periosteum and bone = external callus.
2. Between bony fragments = permanent or intermediate callus.
3. As a medullary plug = internal callus (*Fig. 50, A*).
Calcification occurs first in the external, then in the internal, and last in the intermediate callus.

Amount of callus is in proportion to movement and irritation.

THIRD WEEK TO EIGHTH WEEK.—

CONVERSION OF CALLUS INTO BONE.—Callus becomes more dense by further calcification which surrounds its vessels. Original bone becomes rarefied, and its vessels become continuous with those of the callus.

FINALLY.—External and internal callus disappear by rarefying osteitis. Intermediate callus becomes condensed into hard bone by sclerosing osteitis, and this change spreads into the ends of the bone. This may take one or two years in adults.

EXCEPTIONAL CASES.—

IN IRREGULAR FRACTURES with much displacement. The angles between fragments are filled up—Projecting corners of bone removed—Architecture of the bone is remodelled.

COMMUNUTED FRACTURES.—All the fractures are 'set' in callus (*Fig. 50, B*)—Callus becomes densified and old bone rarefied until whole is welded into a homogeneous mass.

WHEN MOBILITY IS NOT PREVENTED.—Excessive external callus is formed—Sometimes cartilage occurs instead of bone.

IN MANY GUNSHOT FRACTURES the progress of repair may be very slow, so that after 6 or 8 months there is little firm callus, and this easily bends. This is due to sepsis, and the deprivation of vascular supply to the injured bones.

FLAT BONES OF SKULL.—With no mobility little repair occurs—No callus is formed—Inner table is united most firmly.

ARTICULAR CARTILAGE is replaced by fibrous tissue; rarely by cartilage.

RIB CARTILAGES are repaired by bony callus.

Microscopical Changes in the Repair of Fractures.—These are exactly similar to the repair of soft parts, with the addition of the processes of calcification and ossification. Thus :—

BLOOD-CLOT between the fractured ends.

Invasion of clot and replacement by LEUCOCYTES AND FIBRO-BLASTS.

HYPERPLASIA of tissues with cellular and plastic exudation.

VASCULARIZATION of this cellular layer by new vessels.

DEPOSIT OF LIME SALTS between the vessels.

Vessels thus lie in tubes of calcareous matter.

CALCAREOUS TUBES are lined by endothelial cells and covered by layer of osteoblasts, each derived from fibroblasts.

OSTEOBLASTS lay down lamellæ of true bone arranged concentrically round the vessels, some cells running between the lamellæ as Haversian cells.

LARGE FIBROBLASTS CALLED OSTEOCLASTS erode the surfaces of the original bone and make it porous, and enlarge the Haversian canals by the same process.

Thus building up of new bone by osteoblasts in callus, and absorption of old bone by osteoclasts, proceed simultaneously and produce homogeneity.

Temporary callus is absorbed by osteoclasts removing the calcified granulation tissue.

Permanent callus is converted into true bone by osteoblasts.

Condensation of this tissue and of the ends of the bone occurs by continuation of the same process.

Treatment of Simple Fractures.—Four cardinal rules :—

1. PREVENT FURTHER INJURY by 'first aid'.
2. SET THE BROKEN BONES in natural position.
3. FIX THE LIMB by retentive apparatus.
4. KEEP THE PART AT REST until union is firm.

REDUCTION OF THE FRACTURE.—

EXTENSION of the limb.

MANIPULATION of the broken ends.

CONTINUOUS TRACTION is necessary sometimes to overcome muscular spasm.

A POSITION OF SEMI-FLEXION of the joints so as to relax the muscles.

AN ANÆSTHETIC to abolish muscular spasm in all difficult cases.

COMPLETENESS OF REDUCTION should be estimated by comparative measurement of sound side, or by a skiagram.

TIME LIMIT FOR REDUCTION.—Within the first week errors of reduction can easily be corrected. After the tenth day parts are 'set' in calcified granulation tissue, and reposition is more difficult.

FIXATION OF FRACTURES.—

1. SPLINTS.—Wood, metal, or leather.

Ought to immobilize the joints above and below—

Fixation of Fractures, continued.

Padded so as not to press too much on bony points—
Wide enough to cover the limb—Applied in the position
in which the part is to remain.

Parts below the fracture should be bandaged to prevent
swelling from oedema—Not so tight as to interfere with
circulation.

2. **FIXED APPARATUS.**—Starch bandages—Silicate bandages—
Plaster-of-Paris: bandages or Croft's apparatus (flannel
moulds of limb made in two parts and impregnated with
plaster)—Leather splints first moulded on to a plaster cast
of the limb (Hessing's splint).

In each of these methods the part is first covered by
wool or flannel bandages. The apparatus may be
strengthened by metal strips.

3. **REST IN BED, WITH TRACTION** sometimes: Fractures of
Spine—Pelvis—Head and neck of the femur.

Rest in bed with splints: Fractures of the thigh and leg.

4. **TRACTION BY MEANS OF STRIPS OF PLASTER** applied well
above the fracture and attached below to a weight or
metal spring.

5. **TRACTION BY MEANS OF A TRANSFIXION PIN, TAUT WIRE,**
or an **ICE-TONGS CALIPER** applied to the bone below the
fracture.

6. **OPERATION**, with mechanical fixation of the fragments:
(a) When reduction cannot be effected. (b) When reduction
cannot be maintained—oblique fractures; especially in
bones of the leg. (c) In some open fractures. (d) Frac-
tures running into joints. (e) Complicated by injury of
the artery or nerves. (f) Combined with a dislocation
when the latter cannot be reduced otherwise. (g) In
patella and olecranon.

Advantages.—Accuracy of reduction. Complications can
be dealt with. Excessive effusion can be removed.
Massage and movement can be performed much earlier.
Functional result is better.

Disadvantages.—Sepsis may occur and produce necrosis.
Screws or wire may cause pain, irritation, or suppura-
tion, and have to be removed later. The essential
tissue-repair is delayed.

Methods.—Screws or bands for oblique fractures. Metal
wire, especially in patella and olecranon. Steel plates
fixed by short screws is the method most widely used.

After-treatment of Fractures.—

MASSAGE.—Removes effusion. Prevents contraction of soft parts,
atrophy of muscles, and adhesions in joints.

WITHOUT REMOVAL OF SPLINTS:—

Begin on second day in all possible cases.

WITH REMOVAL AND RE-APPLICATION OF SPLINTS :—

Begin from third to seventh day in impacted fractures near joints ; in fractures of the neck of humerus and in the neighbourhood of elbow-joint ; Colles's fracture ; Pott's fracture.

Begin at end of second week in fractures of the long bones, except the femur.

Begin at end of third week in fractures of the femur.

PASSIVE MOVEMENTS.—Begin on the third day without disturbing splints, e.g., moving fingers in Colles's fracture.

As in massage when splints have to be removed, provided immobilization can be secured. Passive movement of a limb with a fracture near a joint should consist of simply one movement only in each direction to prevent adhesions.

Complications arising during the Course of Treatment.

HYPOSTATIC PNEUMONIA—BEDSORES : In old people confined to bed.

CRUTCH PALSY, generally of the musculospiral.

ISCHÆMIC PARALYSIS, or Volkmann's contracture (p. 180).

GANGRENE, caused by : Immediate injury to the soft parts—Subsequent thrombosis of the vessels—Rupture of the vessels—Septic inflammation in a compound fracture—Bandage applied too tightly—Swelling of a part under a bandage—Flexion of a limb after bandaging.

Sloughing, from pressure of a badly-padded splint.

Comparison of Results of the Non-Operative and Operative Treatment of Closed (Simple) Fractures of the Long Bones.*

1. In children under 15 years, the non-operative methods give as good results as the operative.
2. In children the only fracture which often gives bad results by non-operative methods is that of both bones of the forearm.
3. By non-operative methods, the older the patient the worse the result of treatment. This is much less the case in the operative methods.
4. Although a good functional result may sometimes accompany a bad anatomical reposition, this is exceptional, and no method which does not guarantee a good anatomical reposition can be regarded as satisfactory.
5. Operative measures can only give the best results when they are applied in the first instance, and not when applied late in the case after other methods have failed.

* Report of the B.M.A. Committee on the Treatment of Fractures.

Open (Compound) Fractures.—Owe all their special features to:—

SEPTIC INFECTION through the wound. If this does not occur, or can be removed, the case progresses and is treated like a simple fracture.

COMPLICATIONS AND RESULTS IN SEPTIC CASES.—

Necrosis of part of the bones—Osteomyelitis—Septicæmia or pyæmia—Secondary hæmorrhage.

PROCESS OF REPAIR IN SEPTIC CASES.—The inflammatory changes, instead of being plastic, are destructive in character. Pus is produced instead of granulation tissue. Bones in infected area have their vessels thrombosed by septic clot, and hence necrose. Necrosed bone is cast off. Wound and gap between bones fill with granulation. The granulations calcify and then ossify.

Time taken by repair is much longer than in aseptic cases, as this time is required to separate the necrosed sequestra.

Treatment of Open (Compound) Fractures.—

EARLY CASES—within 12 hours of infection.—

Give antitetanic serum—500 units—as prophylactic.

Anæsthetize. Disinfect as thoroughly as possible.

Especially do this to any protruding fragment before reduction.

In the case of a grossly dirty wound, the skin edges and soiled soft tissues should be excised and the wound washed out with flavine.

Remove only loose fragments of bone which have no soft tissue connections.

Avoid any kind of internal metal fixation, especially by plates and screws.

Sometimes displacement may be adjusted and fixed by a long bradawl or transfixion pin which can be removed after the limb has been fixed in splint or plaster.

Wound is lightly packed with flavine or closed by a few interrupted sutures.

Limb is fixed in a splint which must afford efficient traction and fixation.

LATE CASES—more than 12 hours after infection, or when the above method has failed.—

Complete wound toilette—excision, débridement.

The wound must be made shallow, so that all crevices are opened up.

The wound is swabbed out with iodine, and then spirit. It is then packed with vaseline gauze. No sutures are used.

The fracture is brought to full length and alinement by manual or mechanical traction, aided if necessary by transfixion pins placed above and below the lesion.

The whole limb is encased in plaster—pins, wound, and fracture—without any window.

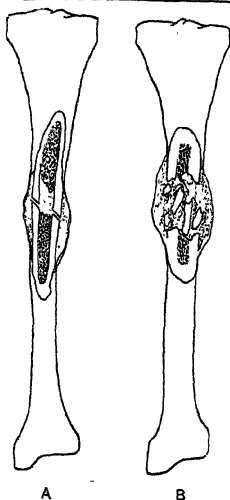


Fig. 50.—Cats' tibiae showing method of fracture repair. A, Simple fracture, with external, internal, and intermediate callus. B, Comminuted fracture, with large callus mass in which the small fragments are embedded.

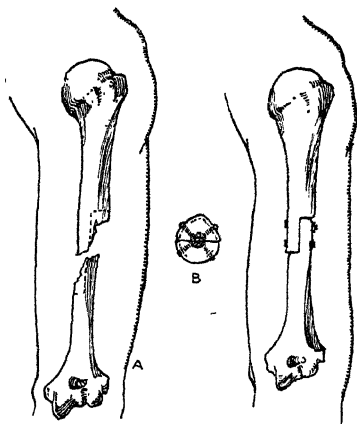


Fig. 51.—Step-cut method of uniting a fracture of the humerus. Suitable for ununited fractures. A, Before operation—dotted lines show lines on which the bone is cut; B, Transverse section of union, showing pins or bolts in different radii; C, Step-cut union, providing a large Z-shaped area of contact between the fragments.

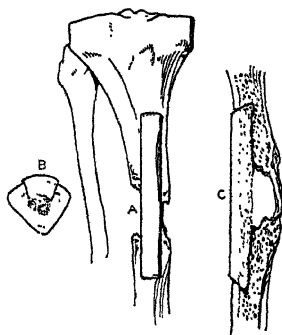


Fig. 52.—Cortical or 'inlay' method of bone grafting. A, Shows graft lying in place from the front; B, Cross-section showing wedge-shaped graft from opposite tibia lying in place; C, Longitudinal section through graft and host bone showing method of shaping the ends of the graft.

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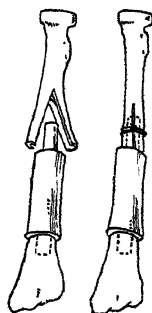


Fig. 53.—Intramedullary method of fixing graft. The graft is shaped like a cricket-bail. One end is driven into the distal fragment, the other is inserted into the proximal fragment by splitting the latter and then tying it over the graft.

I4

Treatment of Open Fractures—Late Cases, *continued*.

The plaster case is left alone without any cutting for 4 to 8 weeks, in spite of the disagreeable odour. Only if pain and persistent temperature occur is the plaster cut open. (Winnett Orr.)

Non-union of Fractures may be of four types: (1) Delayed union; (2) Absolute non-union; (3) Fibrous union; (4) False joint.

COMMONEST SITUATIONS.—Bony processes giving muscular attachments (patella, olecranon, coracoid process, os calcis)—Humerus—Femur (especially the neck)—Tibia.

CAUSES.—

WIDE SEPARATION OF THE FRAGMENTS (e.g., olecranon).

LOSS OF SUBSTANCE (e.g., in gunshot fractures).

CONSTANT MOVEMENT (e.g., humerus).

INTERPOSITION OF SOFT PARTS (e.g., patella).

DEFECTIVE BLOOD-SUPPLY (e.g., head of femur).

GENERAL BONE DISEASE: Osteomalacia.

LOCAL BONE DISEASE: Malignant tumour—Gumma—Tubercle.

SCURVY OR GENERAL ASTHENIA: Very rare.

N.B.—In senility, rickets, fragilitas, paralysis, tabes, bones break easily but heal readily.

IN CHILDREN AND YOUNG ADULTS the cause is very obscure—possibly an undue formation of cartilage instead of bone from the callus.

PATHOLOGY.—There are two types of non-union in the long bones.

THE ATROPHIC TYPE.—This is usually the result of loss of substance with want of contact between the bone ends. The fragments become spindle-shaped and very thin and fragile owing to the absorption of bone salts. The medullary cavity is enlarged and filled with fat.

THE HYPERTROPHIC TYPE. PSEUDO-ARTHRISIS.—The bone-ends become thickened and densely sclerosed. The medullary cavity becomes obliterated by dense bone for some distance from each end. The end margins produce osteophytes like candle guttering. A fibrous capsule with synovial fluid is formed between the ends. The whole resembles an osteoarthritic joint.

SIGNS OF NON-UNION.—Unnatural mobility—Pain: especially in fibrous union.

TREATMENT.—

NON-OPERATIVE.—Heavy massage—percussion. Passive congestion. Active use of limb, supported by suitable splint, e.g., a plaster or leather case. Friction of bone ends together under ether.

OPERATIVE VITALIZATION.—Excision of intermediate scar tissue. Cutting fresh surfaces to bone ends. Drilling holes in the dense bone ends.

OPERATIVE FIXATION.—

1. *Step-cut Operation*.—Shape each bone end by cutting out a step; fit the ends together and fix by suture, bone nails, or both. This is specially suited for the humerus, where the loss of length entailed does not signify (*Fig. 51*).
2. *Cortical Bone Graft*.—A long groove is cut in both fragments. Into this is fitted a bone graft cut from the tibia. Specially suited for the femur or tibia (*Fig. 52*).
3. *Medullary Bone Graft*.—The ragged ends of the fracture are cut off. A graft is cut from the crest of the tibia and its ends are shaped as pegs. The peg ends of the graft are fitted into the marrow cavity of the ends of the broken bone. Specially suitable for gap-fractures of the radius (*Figs. 53, 56*).

FRACTURES OF SPECIAL BONES.

INFERIOR MAXILLA.

CAUSES.—Direct violence (common), indirect (rare).

POSITION OF FRACTURE.—Between canine tooth and mental foramen—Behind angle of jaw—Coronoid process (rare)—Condyle (rare).

SIGNS.—Crepitus—Irregularity of line of teeth—Wound and bleeding into mouth—Always compound owing to communication with mouth—Displacement: anterior fragment downward, posterior fragment upward.

OF CONDYLE: This process is drawn forwards.

OF CORONOID process: It is drawn upwards.

COMPLICATIONS.—In compound cases: Necrosis—Septic pneumonia—Pyæmia.

TREATMENT.—

1. Four-tailed bandage
2. Moulded leather splint
3. Hammond's wire splint round the teeth.
4. Kingsley's splint: Mould over teeth—Connected with outside metal bars—Bars bandaged to chin.
5. Moulded splint over teeth fixed by bars and screws to moulded splint outside and below jaw.
6. Splint between upper and lower jaw, the mouth being open. Jaws bandaged together.
7. Wiring fragments, or better, fixation by a plate and screws.
8. Bone grafting for cases of gap or non-union.

Immobilization is required for three weeks. Feed patient between cheek and teeth. Use frequent antiseptic mouth-washes. (For fractures of the nasal bones, *see* Chap. XXX.)

RIBS.

CAUSE.—Indirect violence (commonest) ; ribs break near the angle.
Direct violence.

RIBS AFFECTED.—Fifth and eighth most commonly.

SYMPTOMS.—Pain on breathing—Irrregularity and crepitus—Pain over fracture on pressing sternum to spine.

COMPLICATIONS (especially in cases of direct violence).—Pleurisy—Pleural effusion : serous, purulent, blood, or air—Wound of lung : hæmoptysis—Surgical emphysema.

TREATMENT.—Strapping rather more than half the chest ; applied in position of expiration. Firm bandage.

When thoracic complication exists—Rest in bed.

CLAVICLE.

CAUSES.—Indirect violence by falls on the hand—Direct violence (rare).

FOUR POSITIONS :—

1. STERNAL END (rare) : Little displacement—Inner end drawn up.
2. MIDDLE (common situation) : Between rhomboid and coracoclavicular ligaments—Fracture runs backwards and inwards—Inner end raised—Outer end depressed, tilted down, approximated to mid-line—Head bent over to affected side—Shoulder displaced downwards, inwards, and forwards.
3. BETWEEN CONOID AND TRAPEZOID LIGAMENTS (direct violence) : Slight displacement—Contusion and crepitus.
4. AT ACROMIAL END (direct violence) : Outer end downwards and forwards.

VARIETIES AND COMPLICATIONS. — Greenstick fracture (common in children)—Compound (rare)—Injury to subclavian vein (rare)—Injury and thrombosis of subclavian artery : gangrene—Wound of pleura and lung.

TREATMENT.—

REPLACEMENT.—Pull shoulder backwards and upwards
Manipulate fragments.

RETENTION.—Required for three weeks.

1. REST IN BED.—Pillow between scapulæ. Arm bandaged to side.

Callus formation reduced to a minimum. Hence useful for ladies.

2. SAYRE'S METHOD (routine method).—Strapping round arm and then round chest, keeping shoulder back. Strapping over opposite shoulder and under bad elbow, keeping shoulder up.

3. BANDAGING both shoulders back. Supporting arm in a sling.

PROGNOSIS.—Usually the patient can return to work in six to eight weeks.

SCAPULA.**VARIETIES.—**

ACROMION.	}	Result from direct violence. Cause slight deformity or crepitus. Treat by raising and fixing the arm.
CORACOID PROCESS.		
BODY.		

NECK.—Anatomical neck: Rare complication of a dislocation.

Surgical neck: Fracture runs downwards from the suprascapular notch. The separated piece includes the coracoid process.

SIGNS.—Flattened shoulder—Prominent acromion—Lengthened arm.

TREATMENT.—Axillary pad—U-shaped leather splint for shoulder.

PROGNOSIS.—This is usually bad, owing to traumatic neurasthenia, osteo-arthritis, or adhesions about the joint. Eight weeks to a year may be taken as the limit of time before which the patient can return to work.

HUMERUS.

Anatomical Neck.—‘Intracapsular fracture’. Results from direct violence.

SIGNS.—Loss of mobility. Great bruising. Head feels irregular from the axilla. Detached fragment may be felt loose in the capsule. Slight shortening of the arm. Crepitus is difficult to obtain. Impaction drives upper fragment into the lower. Any alteration in shape of shoulder is obscured by swelling.

COMPLICATIONS.—Non-union or mal-union may occur. Massive callus is formed during repair. Great stiffness of the joint usually results.

TREATMENT.—Support the arm in a sling. Early massage, and movements from the third day. Open operation to remove or peg an ununited fragment. Never disimpact an impacted fracture.

Surgical Neck.—‘Extracapsular fracture’.

CAUSES.—Direct, rarely indirect, violence.

LINE.—Below the tuberosities. Between the attachments of the short rotators and the attachments of the pectoralis major, teres major, and latissimus dorsi.

DISPLACEMENT.—Lower fragment raised by deltoid, biceps, and triceps, and drawn inwards by the pectoralis major, teres major, and latissimus dorsi.

SIGNS.—Shoulder itself is unaltered in outline. Depression occurs below the shoulder. Line of the humerus points upwards and inwards to axilla. Crepitus is well marked on rotation. Marked shortening occurs. Upper end of the lower fragment may be felt in axilla.

IMPACTION may occur. Lower fragment is driven into the upper. Diagnosis can then only be made certain by X rays

Humerus—Surgical Neck, *continued*.

COMPLICATIONS.—Injury to the axillary vessels. Painful pressure on, or injury of, the nerves, especially of the circumflex nerve. Dislocation may co-exist.

TREATMENT.—

1. Reduction by extension and manipulation, under an anæsthetic in severe cases. The result should always be tested by a skiagram.
 2. Extension, i.e., axial traction in an abducted position. Begin with a straight Thomas arm splint, patient in bed. After ten days put up on an abduction shoulder splint, the elbow being bent (*Fig. 54*).
 3. Open operation for complicated cases. Impact or fix by a peg.
- Massage from the first week. Manipulations from the second week.

Separation of the Upper Epiphysis.—Occurs up to about twenty. End of diaphysis is conical, and the epiphysis is hollowed out. Displacement is usually incomplete owing to the periosteal sleeve. Upper end of diaphysis projects forwards and inwards.

TREATMENT.—As for the last. Open operation if reduction cannot be performed.

Great Tuberosity.—

CAUSE.—Direct or muscular violence.

DISPLACEMENT.—Upwards and backwards by supra- and infra-spinati.

SIGNS.—Bruising and widening of the shoulder—Marked crepitus.

TREATMENT.—Pegging through an open operation. Early massage and movements.

Shaft.—

CAUSES.—Direct, indirect, or muscular violence.

DISPLACEMENT.—

1. Below the pectoral insertion and above the deltoid: Upper fragment inward, lower fragment upwards and outwards.
2. Below the deltoid insertion: Upper fragment outwards, lower inwards and upwards.
3. In lower third: Lower fragment upwards in front of or behind the upper.

COMPLICATIONS.—

Injury of the musculospiral nerve or its involvement in callus. Non-union, due to: Interposition of fibres of the triceps muscle or defective immobilization.

TREATMENT.—

1. Internal angular splint from axilla to wrist, with three short splints over the humerus.
2. Wire traction splint with crutch piece in axilla (*Fig. 55*). The hand is held in a sling.

Lower End.—**1. TRANSVERSE SUPRACONDYLOID.—**

CAUSES.—Indirect violence by falling on the hand with a bent elbow. Direct violence by falling on the bent elbow.

DISPLACEMENT.—Lower fragment upwards, usually behind, rarely in front of, the upper.

SIGNS.—Shortening of the arm from acromion to condyle. Increase in thickness of the lower end of the humerus from before backwards. Unaltered relation of condyles to olecranon. Apparent shortening of the forearm according to backward displacement.

TREATMENT —

Fix in position of flexion after manual reduction, by slinging the wrist to the neck, so that the hand lies on the opposite shoulder. The degree of flexion should never be such as to interfere with the circulation, as judged by the radial pulse.

If accurate reposition is not possible, there are two alternatives, viz.: (1) Apply skeletal traction by a pin or wire through the olecranon, the hand being hung to a Balkan beam, the elbow being at a right angle; (2) Open operation through a posterior incision, impaction of the fragments in correct position, with the aid of kangaroo-tendon sutures if necessary.

2. SEPARATION OF THE LOWER EPIPHYSIS.—May occur up to fourteen or fifteen. Common in children. After fourteen or fifteen it does not involve the internal condyle. Displacement is backwards and outwards.

TREATMENT.—Reduce by flexion. Fix in position of flexion by splints or bandage. Sling for the forearm. Fixation for three weeks.

3. CONDYLES.—

INTERNAL CONDYLE.—Direct violence:—

a. Intracapsular: Involves the epicondyle and part of the trochlea. May result in cubitus varus.

b. Extracapsular: Involves the epicondyle only.

EXTERNAL CONDYLE.—Always intracapsular. Involves the epicondyle and part of the capitellum. May result in cubitus valgus.

SIGNS.—Great swelling and ecchymosis of the joint. Crepitus on grasping the affected condyle. The extended elbow can be adducted or abducted.

TREATMENT.—Fix in a position of flexion by bandages. Employ massage and movements from the end of the first week. If stiffness results in spite of this, excise the displaced fragment. If X rays show that reduction is from the first unsatisfactory, then open the part and fix the condyle by peg or wire.

4. T-SHAPED FRACTURE INTO THE JOINT.—Rapid effusion of blood into the joint. Crepitus on moving the condyles on one another.

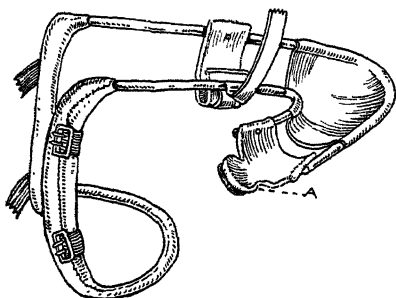


Fig. 54.—Abduction shoulder splint.
A, Adjustable cock-up for wrist.

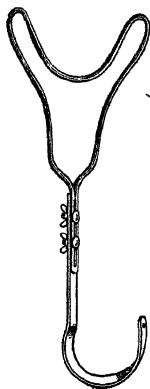


Fig. 55.—Humerus extension splint—adjustable pattern.

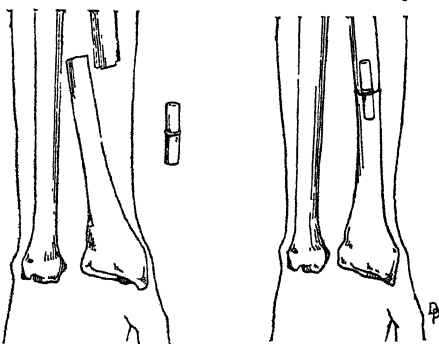


Fig. 56.—Treatment of fractured radius by intramedullary peg.

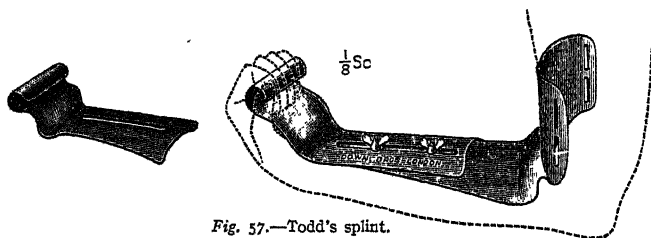


Fig. 57.—Todd's splint.

TREATMENT as above. Open operation or skeletal traction through the olecranon is indicated if reduction cannot be effected.

Prognosis after Fractures of the Humerus.—

THE BEST RESULTS follow fractures of the shaft without complications. Work to be resumed in two or three months.

BAD FUNCTIONAL RESULTS may be expected in:—

FRACTURES INVOLVING THE SHOULDER OR ELBOW, especially the former. Permanent disability is often produced in labouring men. Six months may be regarded as the shortest period of convalescence.

FRACTURES TREATED BY LONG FIXATION WITHOUT MASSAGE.—In cases near the joints permanent disability results.

INJURY TO THE BRACHIAL PLEXUS usually causes permanent inability for hard work.

INJURY TO THE CIRCUMFLEX OR MUSCULOSPIRAL NERVES.—In favourable cases one or two years elapse before work can be done.

ULNA.

Olecranon.—

CAUSES.—Falls on the elbow, or muscular action (rare).

DISPLACEMENT.—Drawn upwards and backwards by the triceps.

SIGNS.—Mobility, with crepitus of the fragment. Great distention of the joint.

COMPLICATIONS.—Forward dislocation of the forearm at the elbow. Injury of the ulnar nerve. Fibrous union.

TREATMENT.—

1. Open operation and wiring. Movements after one week.
2. If an operation is refused, straight anterior splint and 8-bandage.

Coronoid.—Occurs as a complication of backward dislocation of elbow. The dislocation is easily reduced, is accompanied by crepitus, and easily recurs.

TREATMENT.—Fixing in acute flexion. Using early massage and movements (end of first week).

Shaft.—

CAUSE.—Direct violence.

COMPLICATION.—Dislocation of the radius.

DISPLACEMENT.—Lower fragment towards the radius (pronator quadratus), upper fragment forwards (brachialis anticus).

TREATMENT.—As in fractures of both bones.

Styloid Process.—May complicate Colles's fracture of the radius.

RADIUS.

Head.—May be broken as part of a comminuted fracture of elbow. May require excision for non-union or mal-union.

Neck.—Fracture between the head and bicipital tuberosity.

DISPLACEMENT.—Lower fragment forwards (biceps).

SIGNS.—Upper end of the lower fragment forwards. Loss of voluntary rotation.

TREATMENT.—A supination splint, i.e., two flat splints fixed at right angles to one another, the upper part to fit the inner surface of the arm, and the lower the posterior surface of the forearm. Pad in front of the upper end of the radius.

Shaft.**1. ABOVE PRONATOR TERES INSERTION.**

Lower fragment fully pronated and drawn inwards (both pronators).

Upper fragment fully supinated (biceps and supinator brevis).

TREATMENT.—Supination splint. Arm fixed in full supination.

2. BELOW PRONATOR TERES INSERTION.

Upper fragment drawn forwards and inwards (biceps and pronator) in position between supination (biceps) and pronation (pronator).

Lower fragment inwards by the pronator quadratus.

TREATMENT.—Internal angular splint, the hand being midway between pronation and supination. Splints retained for three to four weeks.

OPERATIVE TREATMENT OF FRACTURED RADIUS.—In all cases where displacement is not well reduced by manipulation, immediate operation should be done by pegging (*Fig. 56*) or plating.

Lower End, Backward Displacement (Colles's Fracture).

CAUSES, Etc.—Falls on the outstretched palm. Common in elderly women.

POSITION.—Within one inch of the joint.

DIRECTION.—Transverse, or, more commonly, oblique from above downwards, forwards, and inwards.

DISPLACEMENT.—Is of a quadruple nature. The lower fragment is displaced :—

1. Upwards towards the elbow.
2. Backwards by the direction of the blow and direction of the limb.
3. Rotated round the ulnar styloid as a centre, so that the outer part is more displaced than the inner.
4. Rotated backwards round the line of fracture, so that the back of the fragment is more displaced than the front.

DEFORMITY.—Is also of a fourfold character:—

1. Radial styloid is higher than normal, i.e., it is on a level with the ulnar styloid instead of being below it.
2. Hand is displaced backwards, and there is a bony prominence at the back of the wrist, with another bony prominence at a higher level in front of the wrist (dinner-fork deformity).
3. Hand is abducted to the radial side, with marked prominence of the ulnar styloid process.
4. Wrist is rotated backwards, so that the joint surface looks backwards as well as downwards.

IMPACTION is usually well marked. Hence crepitus and mobility will be absent and the fracture may be mistaken for a sprain. The relative position of the styloid processes is the most important point in guarding against this.

The posterior part of the shaft is driven into the lower fragment. The anterior part of the fragment is driven into the shaft.

TREATMENT.—Reduction of the deformity is absolutely essential. Disimpaction must be carried out under anæsthetic.

Fix on Carr's splint, or any splint which maintains efficient adduction of the hand and leaves fingers free. In cases where displacement is apt to recur, it is wise to put up the wrist in full flexion, on such a splint as Todd's splint (*Fig. 57*). Allow finger movements from the first.

Splints can be removed for light massage and gentle movements from the third day.

'Chauffeur's Fracture'.—This is caused by the back-firing of a motor engine whilst the chauffeur is starting it with a handle. The outer part of the lower end of the radius, with the styloid process, is cracked off but not much displaced. The symptoms are those of a severe sprain. Treatment as in Colles's fracture.

Lower End, Forward Displacement (Smith's Fracture).—

CAUSED by falls on the back of the flexed wrist.

Similar to a Colles's, but all the posterior displacements are now anterior. Produces a rather more square angle, which has given it the name of 'the gardener's fork'.

Separated Lower Epiphysis.—Occurs up to twenty.

Similar to a Colles's fracture. The displacement is more marked. Impaction is rare.

Treatment is the same.

Both Ulna and Radius.—

VARIETIES.—

Direct violence: Both bones broken at seat of impact.

Indirect violence, falls on hand: Ulna broken at a different level from radius.

DISPLACEMENT.—Broken ends tend to be drawn together by the pronators and supinators.

Ulna and Radius, *continued*.

TREATMENT.—Place in full supination or midway between pronation and supination. Fix arm on an internal angular splint, with an external splint bandaged to the forearm. The latter is removed daily for massage. Be careful to have the splints wider than the limb, so that the bandages do not press the bones together. Retain for four weeks.

If marked displacement of the fragments persists, it is better to operate at once, fixing by short intramedullary pegs if there is no comminution, and by plates if there is.

COMPLICATION.—Synostosis of radius and ulna.

Prognosis after Fractures of the Forearm.—

BAD RESULTS ARE OBTAINED and function often never regained in :—

Separation of the coronoid process.

Fractures of the neck of the radius or the shaft above the pronator insertion, if displacement has not been corrected.

Colles's fracture, not replaced, or immobilized too much.

Fractures of both bones with synostosis.

PROGNOSIS IS DOUBTFUL and work can only be resumed within three to six months in : Fractures of both bones ; Colles's fracture in elderly patients.

PROGNOSIS IS GOOD in fractures of one bone only, if massage and movements have been carried out early and thoroughly.

CARPALS, METACARPALS, AND PHALANGES.

CAUSE.—Direct injury. Either transverse or longitudinal fissured fractures. Often run into joints and complicate sprains. Should always be looked for by X rays.

SCAPHOID OR OS MAGNUM may alone be broken. The former is most common. A fissure runs across between the articular surfaces.

BENNETT'S FRACTURE.—A part of the base of the first metacarpal bone is cracked off and the shaft usually impacted into it. The fifth metacarpal often sustains a similar injury.

TREATMENT.—Any lateral deviation at the joints corrected. Immobilize by splints. Early massage and movements.

PELVIS.

Above the Brim of the True Pelvis.—Parts of the iliac crest or the crest of the pubis (rare) may be broken off by direct violence.

TREAT by rest in bed, with pelvic bandage.

Involving the True Pelvic Cavity.—

CAUSES.—Crushes or being run over.

POSITION.—Through the pubic and ischial rami into the obturator foramen. Also secondarily through the sacro-iliac joint of the opposite or same side.

COMPLICATIONS.—Laceration of the urethra, bladder, vagina, or rectum.

TREATMENT.—Rest in bed for six or eight weeks. Poroplastic pelvic belt. Appropriate treatment for visceral complications. Tie in a catheter for some days if there is hæmaturia or retention of urine.

Acetabulum.—

POSTERIOR AND UPPER LIPS, with dorsal dislocation of hip. REDUCE and treat by extension and extreme abduction to prevent recurrence.

FLOOR OF THE ACETABULUM, the femoral head being driven into the pelvis. Head of the femur can be felt per rectum.

REDUCE under an anæsthetic if possible.

Tuber Ischiî, Sacrum, Coccyx.—These fractures require no special description. A fractured coccyx may lead to great pain, or unite in a position in which it encroaches on the pelvis; in either case it is best excised.

FEMUR.

At the Junction of the Head and Neck.—Subcapital or transcervical fractures ('intracapsular fracture').

CAUSES.—Slight violence of an indirect nature. Occurs at any age, but is typical in old people. Atrophy of the bony neck, and a more horizontal position of the neck than normal, predispose to its occurrence.

ANATOMY.—Transverse or oblique cleavage between the head and neck. A few fibres of the capsule may feebly connect the two. The majority of the nutrient vessels of the head which run up from the neck are torn.

Impaction is rare: if present, neck is driven into head.

DISPLACEMENT.—Limb rotated outwards by its weight and by external rotators. Drawn up by hamstrings and quadriceps, but the capsule prevents much upward displacement. The actual shortening is therefore slight—about one inch.

REPAIR.—Usually defective. Non-union or fibrous union, due to: (1) Bad vascular supply of the head; (2) Difficulty in fixing the fragments in apposition; (3) Action of synovial fluid and cells; (4) Interposition of fibres of the capsule.

TREATMENT.—

1. ROUTINE METHOD.—Traction under full anæsthesia, until leg is full length, followed by forced abduction and full inversion. Fix the whole limb in plaster and extend up to the nipple. After one or two days the patient should be turned on to the face for an hour daily (Whitman). The plaster is kept on for three months, and renewed for a further three months. (*Fig. 58.*)

Femur—'Intracapsular Fracture'—Treatment, *continued*.

2. OPEN OPERATION for the following:—

- a. Cases in which the Whitman method has failed to produce good union in three months.
 - b. Young active adults in whom rapid restoration is desirable. The head and neck are united by an ivory peg or by an autogenous bone-graft (*Fig. 59*).
3. CASES OF NON-UNION OF OLD STANDING —Remove the head and reconstruct the upper end of the shaft so as to fit into the acetabulum.

At the Junction of the Neck with the Trochanters.—

Basal fractures ('extracapsular fracture').

CAUSES.—Great violence directly applied to the trochanter major.

ANATOMY.—Cleavage is chiefly in the intertrochanteric line. Comminution is common. The neck, great trochanter, and shaft are the chief fragments. Impaction is the rule; the neck is driven into the great trochanter. The joint is always involved in front, though the fracture is usually 'extracapsular' behind.

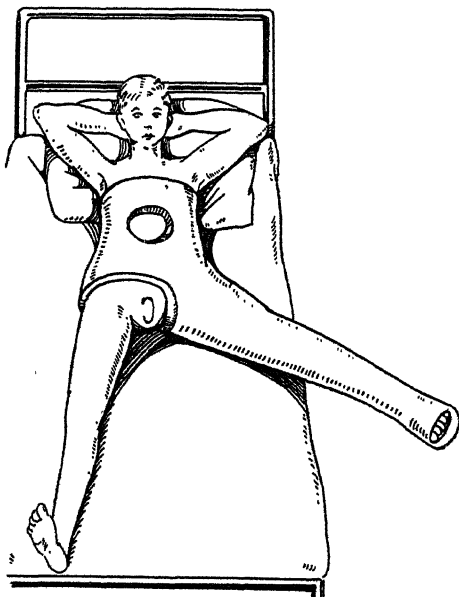


Fig. 58.—Plaster-of-Paris spica for fractured femur (*Whitman*). (*After Keen*.)

DISPLACEMENT.—Leg is rotated outwards by its own weight and the predominance of the external rotators.

SHORTENING IS WELL MARKED, and may be two inches. The length from the anterior superior iliac spine to the malleolus is shortened. The trochanter is raised above Nélaton's line. The horizontal side of Bryant's triangle is shortened.

The trochanter is often nearer to the mid-line than is normal—the 'bi-trochanteric test'.

OTHER SIGNS.—Crepitus is absent when impaction exists. Marked bruising about the trochanter. The trochanteric region is thickened. The ilio-tibial band is relaxed. The trochanter rotates round the arc of a smaller circle than is normal (if not impacted).

TREATMENT.—Always disimpact unless the patient is old and very feeble. Disimpaction requires great force and may need an open operation. After disimpaction, treatment should be:—

1. Whitman's abduction plaster for the feeble and elderly patient.
2. Skeletal traction in position of abduction for young and active patients. This method is less likely to be followed by a stiff hip-joint.

All fractures of the neck of the femur should wear a caliper splint for six months from the time that ambulatory treatment is started. The walking caliper splint is a splint like a Thomas knee-splint, but with the lower end fixed into a boot (*Fig. 60*).

Separation of the Upper Epiphysis.—The head does not join the shaft until eighteen. Its separation results from falls on the leg or hip. Occurs in patients of about fourteen. Its signs are very vague at the time. It results in marked coxa vara from the resulting reconstruction of the head of the bone (*see p. 190*).

TREATMENT.—Fixation in abduction of hip, or operation by a peg, followed by a walking caliper splint for six months.

Shaft.—

CAUSES.—Direct or indirect violence.

POSITION.—Upper, middle, or lower thirds.

DIRECTION.—Transverse, oblique, or spiral.

DISPLACEMENT.—The lower fragment is always drawn up by the thigh muscles, and everted by weight of the limb.

IN FRACTURE OF THE UPPER THIRD, the upper piece is flexed by the psoas; the lower piece is adducted.

IN FRACTURE OF THE MIDDLE THIRD, there is a tendency to backward sagging.

IN FRACTURE OF THE LOWER THIRD, the lower fragment is flexed at the knee by the gastrocnemius; the upper fragment is driven down so as to penetrate the knee-joint or the quadriceps muscle and skin.

Femur, *continued*.

Lower End.—

TRANSVERSE FRACTURE.—Similar to that of the lower third of the shaft. Special liability to backward tilting of the lower fragment by the gastrocnemius. This may cause an injury of the popliteal vessels.

T-SHAPED INTO THE JOINT.

SEPARATION OF ONE CONDYLE.—Rare fractures. Crepitus on pressing one or both condyles. Marked effusion into joint.

SEPARATION OF THE LOWER EPIPHYSIS.—Epiphysis is displaced forwards. The lower end of the shaft presses on the popliteal vessels.

Treatment of Fractured Femur.—

ESSENTIAL PRINCIPLES OF TREATMENT.—

1. The leg must be restored to full length, and this usually involves a stage of over-extension as a preliminary.
2. Correct alinement must be attained.
3. Rotation outwards or inwards of the lower fragment must be prevented.
4. The mobility of the knee must be preserved.

THOMAS'S METHOD.—Extension straps are fixed (plaster or glue) to each side of the leg and thigh, and bandaged in place (*Figs. 61, 62*).

Leg is put up in a Thomas knee splint and traction made upon it until full length is attained.

The straps are tied to the end of the splint.

Kept in place with occasional tightening of straps for six or eight weeks, and then replaced by a Thomas walking caliper splint (*Fig. 60*).

MODIFIED THOMAS'S METHOD.—Extension strapping and splint as above.

Splint is bent at the knee to 135° , or a hinged piece is added (*Fig. 63*).

Leg in splint is slung to an overhead beam, or pulled on by a 15-lb. weight tied to a cord running over a pulley (*Figs. 64, 65*).

Foot is kept dorsiflexed by gauze glued to sole and tied to a wire frame fixed to splint.

HODGEN'S METHOD is practically the same as the last, except that a Hodgen's wire splint is used to sling the leg off the bed.

SKELETAL TRACTION.—In all difficult cases a direct pull on the bones should be substituted for the adhesive plaster or glue.

1. A steel pin 6 in. long and $\frac{3}{16}$ in. thick is passed through the lower end of the femur (*Figs. 66, 67, 68*). Maximum traction is 50 lb. for old fractures, to be reduced to 40 lb. in second week, then 30 lb. in third week, and this to be kept on for four weeks.

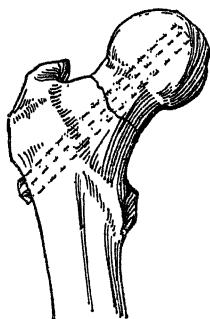


Fig. 59.—Fracture of neck of femur treated by square-shaped peg-graft.

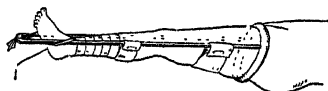


Fig. 61.—Fixed Thomas's splint.

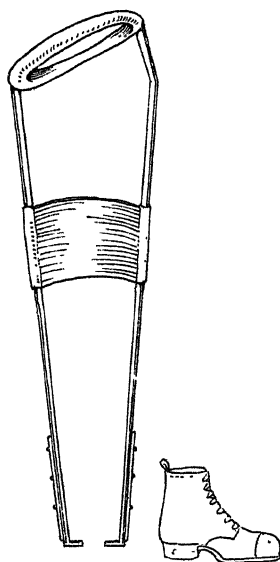


Fig. 60.—Walking caliper splint.

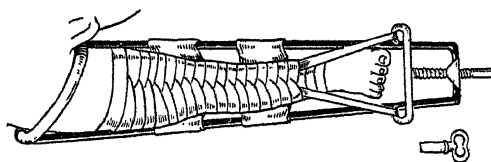


Fig. 62.—Fractured femur treated by Thomas's splint.

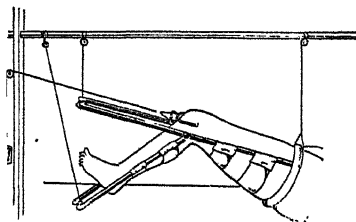


Fig. 63.—Thomas's splint with hinged attachment at knee-joint.

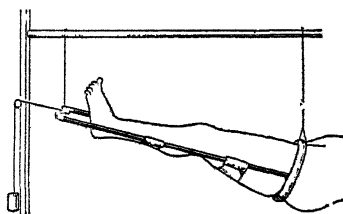


Fig. 64.—Slung Thomas's splint.

Treatment of Fractured Femur, *continued*.

2. A pointed caliper like an ice tongs grasps the lower end of the femur (*Fig. 69*).
3. A pin 4 in. long and $\frac{1}{8}$ in. thick is passed through the crest of tibia just below the tubercle (*Fig. 67*). A good routine method.

Weight of 20 lb. applied by either of these for a week. Reduced to 15 or 10 lb. when over-extension has been attained. The limb is slung in a Thomas's, Hodgen's, or cradle splint with hip and knee bent (*Figs. 63, 70*).

4. A fine wire (2 mm. thick) is passed through the femur or the tibia and strained very tight by a strong horseshoe clamp (Kirschner's wire—*Fig. 71*). This is more complicated in its application, but causes less trauma and less liability to sinus formation than the pin.

IN CHILDREN.—Both legs are slung to an overhead bar so as to raise the buttocks off the bed (*Fig. 72*).

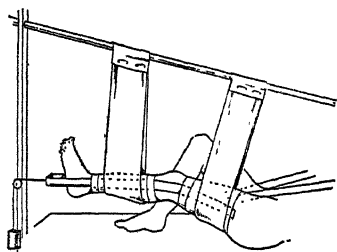


Fig. 65.—Balkan beam.

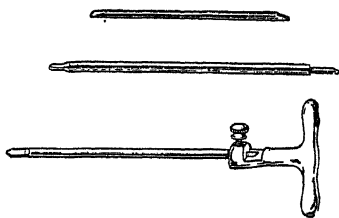


Fig. 66.—Transfixion pins and handle. ($\times \frac{1}{4}$.)

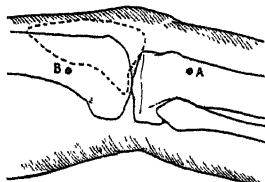


Fig. 67.—Points of transfixion of femur (B) and tibia (A). Dotted lines show limit of synovial membrane.

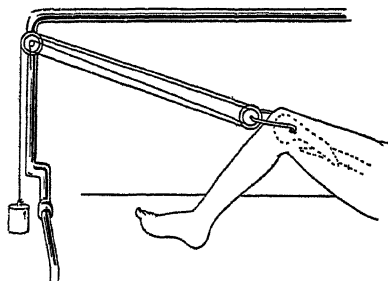


Fig. 68.—Transfixion pin and stirrup, with multiplying pulleys. (The pulleys in the double pulley-blocks are here drawn different sizes to show all four cords. Actually they are both the same size.)

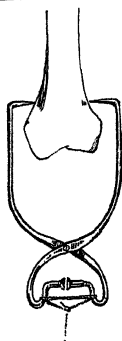


Fig. 69. — Extension caliper (Pearson).

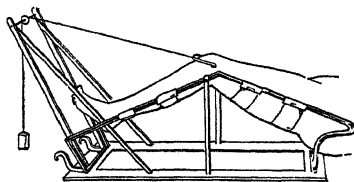


Fig. 70. — The author's cradle splint.

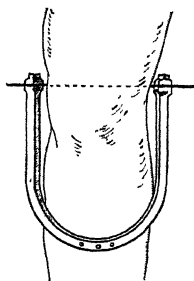


Fig. 71. — Kirschner's taut wire method.

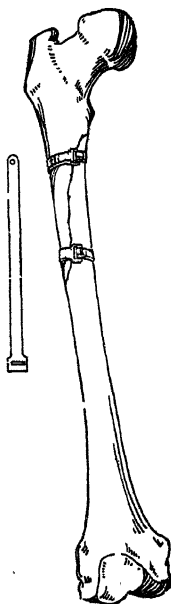


Fig. 73. — Oblique fracture treated by two Parham bands.

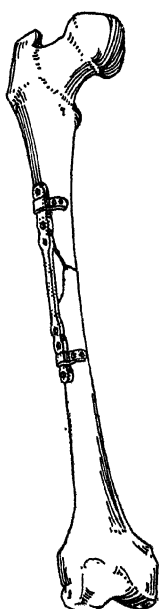


Fig. 74. — Butterfly fracture of shaft treated by clipped plate.

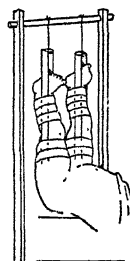


Fig. 72. — Child's legs slung to a gallows splint.

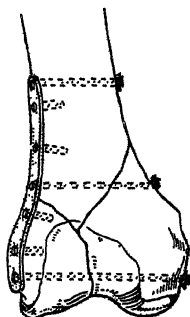


Fig. 75. — T-shaped fracture of condyles treated by bolted plate.

Treatment of Fractured Femur, *continued*.**OPEN OPERATION.—**

For following cases :—

Where efficient pin or caliper traction has failed to reduce.
Certain spiral fractures and those where a third fragment lies crosswise and cannot be reduced by traction.

For T-shaped fractures into knee-joint with marked displacement.

ADVANTAGE OF OPEN OPERATION.—

Accuracy of reduction and fixation.

DISADVANTAGES OF OPERATION.—

Risks of an open operation.

Return to full function is much slower than after equally efficient closed traction methods.

Plates and screws often cause late irritation and have to be removed.

CHOICE OF OPERATION.—

Long oblique or spiral fractures : Fixed by two stout iron wire circles or thin steel bands (Parham's bands—*Fig. 73*).

Transverse fracture without comminution : Intramedullary bone peg (*see Fig. 59*).

Other cases : Plates and screws or bolts (*Figs. 74, 75*).

Prognosis after Fracture of the Femur.—

GOOD, recovery within two months :—

Children. Shaft of the bone, with good replacement.

DOUBTFUL, recovery only after six to twelve months :—

Fractures of the shaft with any rotation or angular deformity.

BAD, with permanent disability for hard work :—

Fractures involving the neck of the bone, or the knee-joint.

Fractures with much mal-union.

PATELLA.**CAUSES.—**

DIRECT VIOLENCE.—Usually produces a stellate or fissured fracture. The aponeurosis is not separated. Little or no displacement results.

INDIRECT, i.e., muscular violence of the quadriceps extensor.

This is the common form to which the following applies.

The patella is broken across the femoral condyles by force applied to its two ends.

ANATOMY.—Marked displacement of the fragments. The ragged aponeurosis of the quadriceps hangs over the divided bony ends. Hæmorrhage and effusion into the joint.

SIGNS.—Inability to extend the knee. Presence of the upper fragment high above the knee. Gap between the fragments.

UNION.—By fibrous tissue forming a band between the fragments. Absence of bony union is due to : (a) Interposition of aponeurosis between the fragments ; (b) Muscular traction separating and tilting the fragments.

TREATMENT.—When separation of the fragments exists, open the joint at the end of the first week. Clear out the blood-clot and cut off the tags. Unite the fragments by wire, or by a strip of fascia lata, which must not encroach on the cartilage. This is best done by encircling the patella by a single loop of wire which lies in the same plane as the front surface.

(All methods of approximating the fragments without freely opening the joint are liable to fail owing to the interposition of the aponeurotic tags.)

Passive movements at the end of the first week.

Active movements at the end of the second week.

TIBIA AND FIBULA.

Tibia.—

AT UPPER END.—Generally results from direct violence. Sometimes T-shaped into the joint. Not much displacement.

TREATMENT.—M'Intyre's splint.

OF THE TUBERCLE.—This may ossify from a separate nucleus, which appears about twelve and joins shaft at fourteen. Generally it grows down as a beak from the head. Generally detached by muscular action of the quadriceps. Sometimes by direct violence.

TREAT by plaster in position of extension, or wire if there is much separation.

OF THE SHAFT.—Caused by direct blows. Transverse above and oblique below. Irregularity of anterior border. Pointed end of upper fragment may pierce the skin.

TREAT by back and side splints, or some open operation.

OF THE INTERNAL MALLEOLUS.—From a blow on the ankle, or from a wrench of the foot inwards. Not so much displacement as in Pott's. Likely to be followed by a stiff ankle.

TREAT by side splints or operation.

Fibula.—

SIGNS are : (1) Localized pain on pressing the two bones together ; (2) Loss of the fibula spring.

TREAT by immobilization with massage.

Tibia and Fibula.—

WHEN FROM DIRECT VIOLENCE.—Bones are broken at the same level. Fracture is transverse. Not much displacement. Great contusion.

WHEN FROM INDIRECT VIOLENCE.—Tibia breaks at junction of middle and lower third. Fibula breaks higher up. Fracture is oblique downwards, forwards, and inwards. Great displacement. Lower fragment drawn up and rotated outwards. Upper fragment often pierces the skin.

Spiral-shaped fracture is produced by torsion. Is specially difficult to reduce.

Tibia and Fibula, continued.

TREATMENT.—

REDUCTION is often difficult. Traction under an anæsthetic with knee flexed. Division of tendo Achillis may help.

PUT UP: (1) In two side splints, the outer having a foot-piece; or (2) In back splint and two side splints. Attach extension weight to lower fragment, and sling from cradle when persistent shortening occurs.

Correct rotation so that the inner margin of great toe, inner malleolus, and inner margin of the patella are in a line. At the end of three weeks use a plaster or leather splint in two halves, and massage daily.

SKELETAL TRACTION.—In oblique and complicated fractures, especially just above ankle-joint. A pin or Kirschner's taut wire is passed through the os calcis, and weight traction made upon this, the leg being slung in a cradle splint (Figs. 76-78).

OPEN OPERATION.—In cases where reduction otherwise is impossible. In cases where reduction cannot be maintained. Especially in the case of working men.

Reduces the time of recovery. Enables massage and passive movements to be performed much earlier.

Pott's Fracture, or fracture-dislocation of the ankle-joint (Fig. 79).

CAUSED BY indirect violence—Tripping or turning the foot.

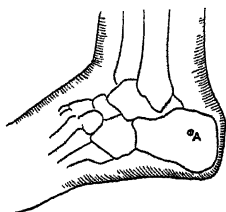


Fig. 76.—Point of transfixion of os calcis.

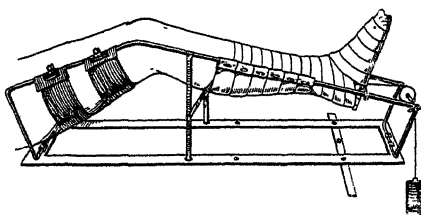


Fig. 77.—Fractured tibia on a short cradle splint.

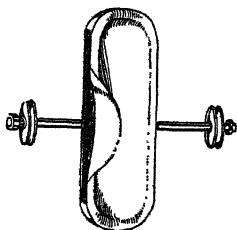


Fig. 78.—Footpiece for use with extension, as in Fig. 77.

Fig. 79.—
Common form
of Pott's frac-
ture.



DISPLACEMENT.—Foot displaced and rotated : (1) Outwards (far the commonest), (2) Inwards, (3) Backwards, or (4) Upwards (rare).

ANATOMY.—The fibula is always broken three or four inches above the ankle. The other lesions affect the ligaments and tibia in four different ways :—

1. Simple rupture of the internal lateral ligament.
2. Fracture of the internal malleolus.
3. Either of the above (1) or (2), combined with rupture of the interosseous ligament and great outward or even upward dislocation of the foot (Dupuytren's fracture).
4. Fracture of the lower end of the tibia. Lower end of the upper tibial fragment forms sharp prominence which may project through the skin.

SIGNS.—Great swelling from bleeding and effusion into the ankle-joint. Foot is displaced, generally outwards and slightly backwards, and rotated outwards.

Internal malleolus is very prominent. Fracture of the fibula three or four inches above ankle.

Crepitus may be felt, and there is loss of the fibula spring.

TREATMENT.—

REDUCE UNDER ANÆSTHETIC.—Traction with rotation of the foot. Keep the knee bent to relax the gastrocnemius. Cut tendo Achillis where much spasm exists.

PUT UP on back splint with foot-piece and two side splints. Inner splint with thick pad to come over inner ankle (Dupuytren's splint). Or a plaster-of-Paris case, split into halves. Or stocking suspension (*Fig. 80*).

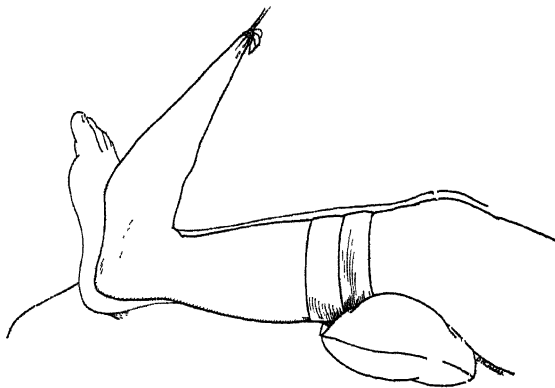


Fig. 80.—Stocking suspension for fracture about the ankle-joint. The knee is slightly flexed by slinging or by a pillow. A piece of stockingette is placed on the leg and its upper edge fixed to the skin by adhesive plaster. The fracture dislocation having been fully corrected, the foot is slung to an overhead support so as to secure (a) dorsiflexion, (b) forward position of the foot, and (c) inversion.

Pott's Fracture—Treatment, *continued*.

POSITION TO BE ATTAINED.—Foot at right angles to the leg, Heel brought forward. Rotation and external displacement corrected until great toe, inner ankle, and patella are in line.

AFTER-TREATMENT.—Remove the side splints and give daily massage at the end of the first week. Gentle passive movements at the end of a fortnight. In three weeks provide case splint, which can be removed daily for passive exercise and massage.

Boot should be made with inner edge of sole and heel thicker than outer, so as to take strain off the internal ligaments of the ankle and prevent valgus deformity.

Prognosis after Lower Leg Fractures.—

GOOD, with ability for hard work within three months :—

Fracture of one bone only with little displacement.

DOUBTFUL.—Return to work within six to twelve months :—

Fractures of both bones, or Pott's fracture, with good treatment.

BAD.—Permanent disability :—

Fractures of both bones with much displacement, not fully corrected.

Pott's fracture if treated by long immobilization, or if not fully replaced.

CHAPTER XXI.

DISEASES OF BONES.**INFLAMMATORY DISEASES OF BONES.****Structure of Bones.—****HARD PARTS.—**

DENSE BONE forms shaft of long bones, outer and inner tables of flat bones, and outer shell of short bones.

CANCELLOUS BONE forms interior of epiphyses and epiphysial ends of shafts of long bones, also interior of short and flat bones.

SOFT PARTS.—

PERIOSTEUM.—A vascular membrane outside bones, with deep layer of growing cells. It ceases where the epiphysis joins the shaft.

MEDULLA.—A very vascular and lymphatic mass of cellular tissue inside the cancellous tissue and in shaft of long bones.

Haversian Canal System.—Minute vessels which traverse the dense bone, and unite periosteal with medullary vessels.

CARTILAGE.—

Epiphysial.—A vascular layer of growing cartilage between epiphysis and diaphysis, from which the growth of the shaft in length takes place. Its circumference is connected with the periosteum.

Articular.—Smooth cartilage covering articular ends of the diaphysis. Non-vascular.

VESSELS.—

NUTRIENT ARTERY, with vein and lymphatics, pierce shaft and end in the medulla.

PERIOSTEAL VESSELS supply the periosteum and send inward branches to Haversian canals.

EPIPHYSIAL VESSELS, given off from the vascular anastomosis round the joint to the epiphysis, especially at the junction with the shaft, where they supply the epiphysial cartilage.

HAVERSIAN VESSELS.—Minute twigs which join the periosteal with the medullary vascular system.

LYMPHATICS are present in the perivascular sheaths.

Relation of Inflammatory Processes to Bone Tissues.—

ORIGIN.—Inflammation always begins in the vascular soft tissues, i.e., in periosteum, medulla, or epiphysial cartilage.

Inflammatory Processes in Bone Tissues, *continued*.

EXTENSION.—Inflammatory processes spread from periosteum to medulla, or from medulla to periosteum, by: (1) Haversian canal system; (2) Epiphyseal cartilage.

THE HARD PARTS of the bone may be regarded as intercellular material, which reacts in three different ways to inflammation:—

1. **NECROSIS.**—Death *en masse* from acute inflammation with vascular thrombosis.
2. **CARIES.**—Molecular necrosis or ulceration, from subacute inflammation.
3. **SCLEROSIS.**—From chronic inflammation laying down new bone.

Necrosis is caused by:—

Periostitis: Acute localized—Acute infective—Chronic syphilitic.

Osteomyelitis: Acute localized or septic—Acute infective—

Subacute septic, tuberculous, syphilitic.

Toxic poisoning: Phosphorus—Mercury.

Senile necrosis, corresponding to senile gangrene.

'Quiet necrosis' is a traumatic form, probably of infective origin, but in which the infective agent, and therefore inflammation, becomes quiescent.

Necrosis corresponds to gangrene or sloughing of soft parts.

Caries.—An inflammatory rarefaction of bone: Simple (as in repair of fractures)—Septic (inflammation of cancellous tissue)—Tuberculous (the commonest form of caries)—Syphilitic.

CARIES SICCA.—Caries without suppuration.

CARIES SUPPURATIVA.—Caries with suppuration.

CARIES FUNGOSA.—Caries with exuberant granulations.

CARIES NECROTICA.—Caries associated with necrosis of minute portions of bone: corresponding to ulceration with sloughing of soft parts.

Caries corresponds to ulceration of soft parts, and fibroblasts of granulation tissue are represented by multinuclear cells called osteoclasts, which eat into and absorb the cancellous bone.

Sclerosis results from chronic inflammatory processes: Chronic periostitis—Chronic osteomyelitis.

SIMPLE—in the proximity of some inflammatory focus in soft parts, e.g., chronic ulcer over tibia.

SYPHILITIC—much the commonest.

TUBERCULOUS—rare; beyond area of tuberculous affection.

Sclerosis corresponds to fibrosis of soft tissue, and results from a laying down of fresh bone (corresponding to intercellular fibrous tissue) by medulla, periosteum, and Haversian vessels.

PERIOSTITIS.**VARIETIES.**—

ACUTE LOCALIZED.

ACUTE DIFFUSE OR INFECTIVE.—Generally associated with infective osteomyelitis as cause or effect.

CHRONIC.—Simple—Tuberculous—Syphilitic (local, general).

Acute Local Periostritis.—

CAUSES.—Traumatism—Rheumatism—Specific fevers—Pyæmia—Gout—Alveolar abscess.

RESULTS.—(1) Resolution; (2) Chronic thickening; (3) Suppuration with necrosis.

PATHOLOGY.—

IN ASEPTIC CASES.—Exudation from deep layer of periosteum. Organization of this exudation.

IN SEPTIC CASES.—Exudation from deep layer of periosteum. Thrombosis of vessels. Suppuration of the exudation. Rupture of vessels passing from periosteum to underlying bone, caused by tension of exudation. Necrosis of fragment of bone which is separated from its periosteum.

Necrosed fragment is called the SEQUESTRUM.

Living bone round sequestrum is rarefied by the inflammatory proliferation of cells forming GRANULATION TISSUE.

REACTION BETWEEN GRANULATION TISSUE AND SEQUESTRUM may be :—

1. Absorption of sequestrum if small and sepsis is at an end.
2. Erosion of sequestrum by granulations until it is separated from living bone.
3. If sepsis is still active, the living bone will be absorbed by granulation tissue until sequestrum lies free. Occupies about four to eight weeks.

Deep surface of separated periosteum in the meantime forms new bone—the INVOLUCRUM.

Pus under the periosteum escapes through periosteum and soft tissues. This opening remains in the involucrum, and is called a CLOACA.

The sequestrum escapes through the cloaca when it is loose, and if the cloaca is large enough.

After the escape of the sequestrum, the granulation tissue lining the living bone becomes ossified, forming a dense layer of osteosclerosis.

TREATMENT.—As for osteomyelitis.

Acute Diffuse or Infective Periostritis is practically the same disease as ACUTE INFECTIVE OSTEOMYELITIS (p. 236), the one being the cause or effect of the other.

Chronic Periostritis.—See CHRONIC OSTEOPERIOSTITIS (p. 239).

OSTEOMYELITIS.**VARIETIES.**—

ACUTE INFECTIVE—associated as cause or effect with infective periostritis.

TRAUMATIC.

SUBACUTE: Simple or infective—Associated with repair of fractures, and with separation of sequestra.

CHRONIC: Simple—Tuberculous—Syphilitic.

EPIPHYSITIS is an acute infective osteomyelitis of the epiphysis.

Acute Infective Osteomyelitis (Figs. 81, 82, 83).—**ETIOLOGY AND PATHOLOGY.**—

CHILDREN, five to fifteen being the commonest age, that is, when the epiphyseal cartilages are in full activity.

Supervenes on a condition of general DEBILITY.

Often follows EXANTHEMATA, e.g., scarlet fever.

Often follows SEPTIC ULCERS of mouth, throat, or intestines.

Generally results from a BLOW or WRENCH.

Caused by entrance of PYOGENIC MICRO-ORGANISMS:—

Staphylococcus pyogenes aureus. Common type.

Staphylococcus pyogenes albus. Mild type.

Streptococcus pyogenes. Young children. Very fatal. Less extensive necrosis.

Pneumococcus.

Bacillus coli communis, in mixed infection.

PRIMARY BONY FOCUS is usually the growing vascular tissue on the shaft side of epiphyseal cartilage, called the metaphysis.

VARIETIES of infective osteomyelitis:—

1. MEDULLARY OSTEOMYELITIS.—Medulla becomes inflamed, the veins thrombosed, and pyæmia often follows. Haversian vessels are infected. Bony walls of Haversian canals being unyielding, the exudation causes strangulation of vessels. This cessation of

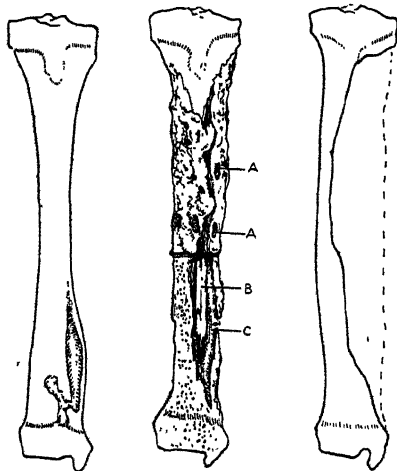


Fig. 81.

Fig. 82.

Fig. 83.

Fig. 81.—Osteomyelitis, early stage. Infective focus at junction of diaphysis and epiphysis. Pus has spread to the surface of the bone and has partly stripped the periosteum.

Fig. 82.—Osteomyelitis, late stage. A massive sheath of new inflammatory bone (the involucrum) has formed round the original shaft, which now lies dead as a sequestrum (B). A cavity filled with pus (C) lies between the sequestrum and the involucrum, and communicates with the exterior by apertures (A) in the latter, called cloacæ.

Fig. 83.—Osteomyelitis. Diagram showing method of treatment in late stages. The involucrum is cut away on one side of the bone, and the sequestrum removed.

circulation and the toxins kill the bone, producing total necrosis. Periosteum is infected. Its deep layers suppurate, and it is stripped off the shaft.

Epiphyses escape because :—

- a. They have an independent blood-supply.
 - b. They are separated from the shaft by a comparatively avascular zone of cartilage.
 - c. They have no periosteum through which infection can take place.
2. ACUTE ARTHRITIS.—Suppuration will extend into the neighbouring joint :—
- a. If the epiphysal cartilage lies within the joint capsule, e.g., hip or elbow.
 - b. In infants, where epiphysis consists of thin cartilage only, this may be perforated, and pus so reaches the joint cavity.
 - c. By extension along soft tissues, e.g., biceps tendon into the shoulder-joint.
3. CHRONIC ABSCESS.—Where infection is mild and resistance is good, the inflammatory process may be limited, and an abscess forms in the cancellous tissue, surrounded by dense thickened layer of osteosclerosis. Commonest at upper end of tibia, lower end of femur, or lower end of tibia (*Fig. 84*). A similar abscess may result from tubercle.

TERMINATION.—Apart from complications, all varieties except the last two present three stages :—

1. STAGE OF INFECTION and suppuration, when the periosteum is stripped off all or a part of the shaft.
2. STAGE OF PERIOSTEAL OSSIFICATION.—The pus escapes through one or more openings in the periosteum and soft tissues. These are the cloacæ. The deep layer of the periosteum produces a shaft of new bone—the involucrum.
3. STAGE OF SEPARATION OF THE SEQUESTRUM.—Sequestrum is separated from the living bone (in total necrosis this will

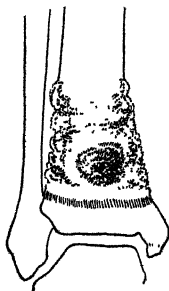


Fig. 84.—'Brodie's abscess' of the tibia. A chronic staphylococcal infection at the lower end of the bone arising at the epiphysal junction and spreading out towards the periosteum. If not treated early it causes massive thickening of the bone.

Acute Infective Osteomyelitis—Termination, *continued*.

be at its two ends). This occupies about four weeks in the case of small bones, up to three months in the case of the femur.

SYMPTOMS.—Rigor, with high fever. Severe pains in the limb. Brawny swelling of soft parts. Absence of the scarlet flush of superficial inflammation. Tenderness is very great. Joint can often be moved gently without pain. Severe toxic and pyæmic symptoms.

COMPLICATIONS.—

LOCAL.—Acute arthritis (*see above*, p. 237). Sloughing of the periosteum, preventing the regeneration of the bone. Destruction of epiphysal cartilage, stunting growth. Overgrowth of the bone by stimulation of chronic inflammation and long-standing hyperæmia.

GENERAL.—Septicæmia—Pyæmia—Lardaceous disease.

PROGNOSIS.—Always grave. It is severe in proportion to: Youth of patient—Debility of patient—Size of the bone—Extent of the bone disease—Virulence of infection.

Streptococcal infection is almost hopeless.

Staphylococcus aureus infection is grave.

Staphylococcus albus infection is milder.

TREATMENT.—

GENERAL TREATMENT suitable for fever.

CUT DOWN through the periosteum on to the shaft AS SOON AS THE DIAGNOSIS IS MADE OR APPEARS PROBABLE.

TREPHINE or gouge shaft so as to open into medulla or cancellous tissue. Pack with antiseptic gauze and drain.

CLOSED VASELINE PACK.—The cavity in the bone is made as wide and shallow as possible (like a saucer), and the soft parts are drawn aside. The whole cavity after swabbing with iodine and spirit is packed with vaseline gauze without any sutures. The whole limb is encased in plaster-of-Paris so as to give absolute fixation of the joints above and below the inflamed bone. No window is cut. The plaster is left for 4 to 8 weeks in spite of unpleasant smell. Only increase of pain or persistent rise of temperature requires the plaster to be cut. The wound toilet, vaseline pack, and plaster are renewed at intervals of 6 to 8 weeks, and after about two or three such renewals the case will have healed. This treatment saves many months in hospital, and many painful dressings. (Winnett Orr.)

If total necrosis has occurred, cut sequestrum in two and twist each end off from epiphysis: except in case of humerus or femur, when sequestrotomy must be delayed until the involucrum has formed.

When involucrum has formed, wait until examination by the probe shows that the sequestrum is loose, then enlarge cloacæ and remove sequestrum.

AMPUTATION may be needed : When sequestrum is inaccessible, e.g., at the back of lower end of the femur—When pyæmia is present—When exhaustion threatens life—When suppuration in a large joint occurs—When lardaceous disease has begun.

Traumatic Osteomyelitis.—

CAUSES.—Septic compound fractures—Amputations—Any bone operation.

SYMPTOMS.—Inflammation and suppuration of wound—End of the bone is seen or felt to be white and bare.

High temperature, with rigors or pyæmia, may occur.

Portion of the bone is extruded as the sequestrum.

SEQUESTRUM : Tubular or conical. Its outer surface is pitted by granulations.

TREATMENT.—Open up wound. Scrape out medullary tissue and drain. Amputate if pyæmia persists.

CHRONIC OSTEOPERIOSTITIS.

Usually primarily a periostitis, but by extension the disease affects the Haversian canals and medulla, and produces a general sclerosis and thickening of the bone.

LOCAL.—Caused by local periostitis, e.g., beneath a chronic ulcer, or by trauma, rheumatism, syphilis. A hard node is formed by new periosteal bone, in which the Haversian canals run at right angles to the surface. Later this becomes sclerosed.

DIFFUSE.—As an extension from the local variety.

In syphilis as a primary diffuse periostitis or round a central gumma.

In tubercle from a central abscess or other chronic focus.

SYMPTOMS.—Deep aching pain, worse at night. Bone is felt to be thickened, and seen to be so by the X rays.

TREATMENT.—Rest, counter-irritation, with iodides internally.

If the pain is severe, an operation may be necessary. The bone is exposed, the periosteum stripped off, and the medulla opened by the trephine or gouge.

Amputation may be required in the worst cases.

TUBERCULOUS DISEASE OF BONES.

Varieties of Tuberculous Disease.—

1. MILIARY TUBERCLE.—Very rarely found in the bones in general infection.
2. CASEOUS FOCI.—Usually situated towards the end and near the surface. The following zones occur from within outwards :—
 - a. A MASS OF CASEOUS MATERIAL occupies the centre.

Tuberculous Disease of Bones—Varieties, *continued*.

This represents the first seat of the disease, the cells of which have died and undergone fatty degeneration.

- b. GRANULATION TISSUE containing tubercles in which all bony trabeculæ have been absorbed.
- c. A ZONE OF SCLEROSIS, containing small round cells instead of fatty tissue.
- d. A ZONE OF RAREFYING OSTEITIS at some distance from the deposit.

The whole process spreads to the periphery, whether joint or periosteal surface.

- 3. NECROSIS WITH SEQUESTRUM FORMATION.—This also occurs chiefly in the ends of long bones. The sequestra vary in size, and are often wedge-shaped, with the base of the wedge towards the joint. Here three zones occur, viz. :—

- a. THE CENTRAL SEQUESTRUM, in which the trabeculæ are thickened.
- b. A ZONE OF TUBERCULOUS GRANULATIONS.
- c. A ZONE OF RAREFYING OSTEITIS.

The formation of caseous foci and of sequestra often occurs at the same time and locality. The sequestra often remain attached for a long time to the living bone at one spot.

- 4. SUPERFICIAL CRIES.—This occurs beneath the cartilage of a joint or the periosteum of the shaft. The surface is covered by caseous débris. Beneath this is more or less osteosclerosis. At a little further distance a zone of osteoporosis. It very seldom extends deeper than a quarter of an inch from the surface.
- 5. TUBERCULOUS PERIOSTITIS.—Commonest in the ribs and vertebræ. Produces caries of the underlying bone, together with chronic abscesses spreading along the bones and tracking to a distance.
- 6. OSTEOMYELITIS (also epiphysitis).—Most often seen in the phalangeal, tarsal, and carpal bones.

STRUMOUS DACTYLITIS is common in children. A localized swelling occurs over a phalanx or metacarpal bone, in which tuberculous caseous processes expand the bone and break through the outer shell.

In adults, diffuse thickening from periostitis and the formation of central sequestra is commoner.

In either case neighbouring structures are affected by extension, viz. : (1) Joints ; (2) Tendon sheaths ; (3) Adjacent bones, especially in the wrist and ankle.

- 7. CRIES SICCA.—Is very rare, except in the shoulder-joint. Instead of soft tuberculous granulation tissue, firm fibrous tissue forms on the surface, and the bone steadily atrophies. It is accompanied by ankylosis with muscular atrophy.

8. **DIFFUSE OSTEOSCLEROSIS.**—This occurs for some distance along the shaft of a bone in the neighbourhood of an old tuberculous process. The bone becomes dense and thick.
9. **DIFFUSE SOFTENING.**—The rarest of all changes. Only seen in rapid cases where the disease spreads from one bone to another. There is a great enlargement of the medullary cavity and increase of the red marrow, with general absorption of the hard bone.
10. **CHRONIC DEEP ABSCESS.**—Usually situated near the epiphysal line. It is lined by a thick pyogenic membrane and surrounded by a thickened mass of sclerosed bone. This thickening often extends up the shaft.

Distribution of Tuberculous Bone Lesions.—

CRANIAL BONES.—Rarely become carious, with external abscess.
VERTEBRÆ.—Central osteomyelitis or superficial caries.

RIBS.—Periostitis with abscess.

LONG BONES.—Epiphyses: caseation, necrosis, osteomyelitis, or chronic abscess—this is much the commonest situation.
 Diaphyses: rarely the seat of periostitis, osteomyelitis, or chronic abscess.

PELVIS.—Near the sacro-iliac joint or any of the epiphyses, e.g., the crest of the ilium.

CARPAL, TARSAL, AND PHALANGEAL BONES.—Commonly affected by osteomyelitis, necrosis, or caries. The os calcis, astragalus, scaphoid, or one phalanx, may be separately diseased, but usually more than one bone or joint are affected.

Clinical Signs.—

PAIN.—Generally in proportion to the depth of the lesion and its subjection to pressure.

SWELLING.—(1) Of the bone; (2) Of the soft parts over it, (3) Abscess.

ABSCESS.—An abscess forms without inflammatory phenomena, and in deep bone disease tracks to a distance.

FEVER.—Usually absent before the abscess breaks or becomes infected. Occasionally is well marked in purely tuberculous abscess of bones.

JOINT SYMPTOMS.—Deformity, immobility, pain, etc.

Treatment.—

CONSTITUTIONAL TREATMENT, with rest to the affected part by splints. Passive hyperæmia in suitable cases.

OPERATIVE.—When the above has failed, or on the occurrence of an abscess, the part is laid open, the diseased part scraped away, sequestra are removed, and the cavity is rubbed with iodoform or filled with iodoform wax.

AMPUTATION is rarely required, and then generally in the case of a finger, hand, or foot, where the disease has spread to several bones and joints.

SYPHILIS OF BONES.

Secondary Syphilis.—

SYMMETRICAL LOCALIZED PERIOSTITIS forming hard nodes. These occur most commonly on the tibia, and are associated with aching pain, worse when the part is warm, e.g., at night. It is a late secondary lesion, and may also occur in the tertiary stage.

Tertiary Syphilis.—

1. GUMMATA.—These are usually subperiosteal.

THE CRANIAL BONES are the commonest site, especially the frontals and parietals. A firm nodular swelling first appears, which then softens and fluctuates. Bone beneath presents: (1) CARIOUS DESTRUCTION, whereby a circular clean-punched hole is produced which very rarely perforates the skull; (2) AN OSTEOPLASTIC PERIOSTITIS at the margin, forming dense new bone; (3) AN EXTENSIVE SCLEROSIS, which may affect the whole vault of the skull or only that part under the gumma.

When the gumma breaks and sepsis is admitted, a FOUL

ULCER results and the bone becomes necrosed and black.

BY AN EXTENSION OF THESE PROCESSES a large part of the cranium may be affected: (1) By worm-eaten erosion; (2) By heaping up of new bone; (3) By sclerosis; (4) By necrosis due either to sepsis or to a cutting off of the blood-supply by sclerosis. The sequestrum remains for years without separating.

BY AN EXTENSION THROUGH THE SKULL, similar conditions may occur between the skull and dura, the deep surfaces of the bones being then affected.

THE PALATE AND MAXILLARY BONES, THE VOMER, ETHMOID, AND NASAL BONES may be destroyed by submucous gummata, or by the extension of tertiary ulceration.

THE LONG BONES are rarely attacked by central gummata. In this case spontaneous fracture may occur, which is very slow in uniting.

2. OSTEOSCLEROSIS.—A diffuse osteoperiostitis may affect any of the bones, but especially the tibia, femur, humerus, radius, and ulna. Constant aching pain, worse at night, is complained of, and the subcutaneous parts of the bone become thickened. The X rays show irregular thickening under the periosteum of the whole shaft. The bone remains permanently hard and heavy, and necrosis may take place. (*See Fig. 16, p. 61.*)

Inherited Syphilis.—

THE SKULL presents low nodular elevations over the frontal and parietal eminences—*Parrot's nodes*. These are caused by periostitis forming a layer of spongy new bone. In some places the bones remain partly or wholly unossified—

craniotabes. The prominence of the frontal eminences, combined with the depressed nasal bridge, is very characteristic. THE NASAL SEPTUM is destroyed by early suppurative rhinitis, and causes a falling in of the bridge of the nose.

THE PALATE is narrow, high, and arched, because of the loss of the nasal septum.

EPIPHYSITIS may occur within the first year. An enlargement of the epiphysis takes place, and extends some distance along the shaft. It affects the knees, elbows, or wrists symmetrically, and may lead to separation of the epiphyses or to acute arthritis. Later on it may lead to increased or diminished growth.

CHRONIC PERIOSTITIS, with osteosclerosis, overgrowth, and anterior bowing of the tibia. Hard nodes may form on any of the long bones.

RICKETS.

Etiology.—

AGE.—Occurs in first and second years (*see also* LATE RICKETS).

CLIMATE, etc.—Cold, damp, and dark encourage it. Large cities have most of the cases.

DIGESTIVE DISTURBANCES.—Slight diarrhoea and vomiting often precede or accompany rickets.

ERRORS OF DIET are the most constant factors.

IN BREAST-FED CHILDREN it is very rare, but occurs on prolonged lactation, or lactation during pregnancy.

IN HAND-FED CHILDREN it is common—either when fed on exclusively farinaceous food, or fed with cow's milk in a form in which the casein and fat are vomited.

THE DEFICIENCY OF PROTEIN, ANIMAL FAT WITH FAT-SOLUBLE VITAMIN, and EARTHY PHOSPHATES in food, is the cause.

DARK UNHYGIENIC DWELLINGS.

INFLUENCE OF SYPHILIS.—The most severe types of rickets are found in congenital syphilis. *Craniotabes*, Parrot's nodes, and visceral enlargements are always suspicious in this respect.

Symptoms and Signs: General.—

ANÆMIA, with marked deficiency in red cells.

MUSCLES are flabby and weak.

BONES are all soft and inclined to bend.

LIGAMENTS soften and stretch.

Tendency to PROFUSE SWEATING, especially over the forehead.

TEMPERATURE is subnormal.

MUCOUS CATARRHS.—Gastro-intestinal catarrh—Laryngitis—Bronchitis and bronchopneumonia.

Protuberant abdomen, with large liver and spleen (these are probably cases complicated by congenital syphilis).

NERVOUS SYMPTOMS.—Convulsions—Laryngismus stridulus (laryngeal spasm often precedes a general convulsion)—Tetany (painful involuntary muscular contraction; especially affects

Rickets—General Symptoms and Signs, *continued*.

the hands and feet; thumb is drawn into the palm, and fingers form cone-shaped hand).

GENERAL NUTRITION.—Two types: (1) Thin; (2) Fat and flabby.

Symptoms and Signs: Bones.—

CRANIUM.—

THIN PATCHES, from deficient inner table = craniotabes.

THICK BOSSES of red vascular bone on parietals, frontal, occipital.

Head is flattened from before backwards.

FOREHEAD is broad, square, and projecting.

FOUR EMINENCES over the frontal and parietals are separated by a + groove.

FONTANELLES (especially the anterior) remain open up to the second or third year.

TEETH erupt late (eleventh or twelfth month). Come in irregular order. Fragile, deficient in enamel, and are shed early. Notched with small segment of a large circle.

THORAX.—Transverse groove at the level of lower end of sternum. Vertical grooves at junction of ribs and cartilages. Prominent sternum. Beading of the ribs where they join the cartilages.

SPINE.—Long curve backwards (kyphosis). Often lateral curve (scoliosis). These often become permanent if they are not corrected before the rickets is cured.

PELVIS.—Contracted and flattened from before backwards. Conjugate diameter, especially at brim, is diminished. Sacro-vertebral angle becomes acuter and more prominent. Anterior superior iliac spines lie as far as or farther out than the crests of the ilia.

ARM BONES.—Enlargement of lower radial epiphysis. Radius and ulna bend when child crawls.

LEG BONES.—Enlargement of epiphyses, especially of lower tibial epiphysis. Bending outward and forward of lower third of tibia. Bowing of the femur outwards and forwards. Talipes valgus. Talipes varus rarely, secondary to bowed tibiae.

Histology.—

EPIPHYSIAL CARTILAGE.—Wider in circumference. More vascular than normal. Thicker: about quarter or half an inch, as compared with normal one-tenth.

Zone of proliferating cartilage cells is thickened. Cells are irregularly arranged. Cells are increased in proportion to matrix.

Zone of calcified cartilage is thickened. Calcification is very irregular.

Line of ossification is uneven. Islets of cartilage are left in the midst of ossified tissue.

SHAFT.—Subperiosteal layer of bone is more vascular and spongy than normal. Hyperplasia and defective ossification occur in the surface of flat bones. Compact bone and cancellous bone have vessels much larger and more numerous than normal, at the expense of the osseous tissue. Haversian canals are wider than normal.

Results on the Bone as a Whole.—The bone is thicker, but weaker. Contains only 40 per cent earthy matter, as compared with normal 60 per cent. Very liable to greenstick fractures. Bends so that all natural curves are exaggerated.

ON RECOVERY.—The spongy bone becomes somewhat denser than normal. The concavities of the curves are filled by buttresses of new bone, and thus the curves tend to be restored to the normal. Premature ossification of the epiphysal cartilages leads to stunting of the growth.

Varieties.—

FÆTAL RICKETS.—Fractures of the bones, bending of the ribs, hyperplasia of cartilages, are sometimes found when the child is born.

SCURVY RICKETS.—Often has a sudden onset, with pyrexia. Extreme tenderness of the limbs. Periosteal swellings of hæmorrhagic nature. Especially over the femur and tibia. The epiphyses may be detached, or spontaneous fractures occur. Spongy gums. Ecchymoses and other hæmorrhages, e.g., hæmaturia, epistaxis, or blood-stained diarrhœa, combined with other signs of rickets.

LATE RICKETS.—Occurs about the age of puberty. Is similar to ordinary rickets, but its effects are confined to the long bones, and the constitutional symptoms are much less marked. Its cause is unknown.

Treatment.—

THE DIET should contain fresh protein and fat in an assimilable form. Fresh milk, properly diluted and peptonized, if necessary, or mixed with lime-water. Raw meat juice, cream and eggs, custard puddings. Also lime-juice, fruit, and vegetables in scurvy rickets.

SUNSHINE AND FRESH AIR.

DRUGS.—These are only of secondary importance. Cod-liver oil in thin children, and phosphate of iron.

SURGICAL.—In the acute stage of rickets, deformities should be prevented or corrected by splints, bandages, and manipulations, the child not being allowed to walk.

For deformities of the legs left after rickets has ceased, osteotomy will generally be required.

PSEUDOCOXALGIA.

(*Perthes' Disease; Osteochondritis Juvenilis Deformans*).

Definition.—A flattening of the epiphysis of the head of the femur. An affection of the epiphysis allied to Schlatter's disease of the tibial epiphysis and Köhler's disease of the tarsal scaphoid.

Etiology.—Generally occurs in healthy boys aged 3 to 12.

Pathology.—Exact cause unknown. Probably a low-grade pyogenic infection or the result of trauma. Head of femur becomes fragmented and later 'mushroomed', with shortening of neck.

Clinical Features.—Slight pain in hip. Moderate limp. All movements limited, especially internal rotation and abduction. X-ray examination shows fragmentation of head, but bone is of normal density and edges are sharply defined (cf. tuberculous hip).

Treatment.—Immobilize in plaster of Paris for three months, and then relieve weight-bearing by fitting walking caliper splint for at least six months.

ACHONDROPLASIA.

Definition.—A defective growth of all the bones which develop from cartilage. It differs from rickets in not manifesting its results until some years after birth. It is often hereditary.

Stunting of the Long Bones.—The growth of the shaft of the bones from the epiphyseal cartilage is very slight, so that the limbs grow in thickness but not in length. The adult is a dwarf.

Changes in the Head.—The vault of the skull, which grows from membrane, is normal, whilst the base of the cranium and face are stunted. Mental condition is normal.

Hands.—The stumpy, thick fingers cannot touch one another at their tips, but diverge like the spokes of a wheel.

OSTEOMALACIA.

Definition.—An absorption of the hard parts of the bones, resulting in bending and fractures.

Etiology.—In over 90 per cent it affects women, and usually begins during pregnancy.

Pathology.—The compact parts of the bone are replaced by a fibro-cellular tissue, whilst very vascular pulpy marrow fills the medullary cavity. The earthy salts are reduced to a sixth of their normal proportion. Possibly the absorption of the bony salts may be due to the over-production of an internal secretion by the ovaries, together with lack of sunlight.

Symptoms.—Severe deep-seated pain in the spine, pelvis, and leg bones. Emaciation and exhaustion. Later the limbs become bent or broken, and the pelvis is pressed into a triradiate shape which makes parturition impossible.

Treatment.—Oophorectomy.

GENERALIZED OSTEITIS FIBROSA.

(*Fibrocystic Disease; Von Recklinghausen's Disease.*)

Definition.—A disease of middle age, in which a development of fibrous tissue and cysts occurs in the shafts of the long bones, females being more often affected than males.

Symptoms.—Pain of a dull aching character is common, even before fracture has taken place. General lassitude and debility are present in advanced cases. Commonly only one or two bones are affected. Sometimes many of the long bones and phalanges, together with the skull and pelvis, are the seat of disease.

Three abnormal tissues may take the place of the bone-marrow or of the cancellous tissue, and these may be present alone or together in varying proportions:—

1. Cysts with a simple lining. These may develop after a fracture, or they may be the cause of a spontaneous fracture.
2. Large masses of white fibrous tissue which cuts like a turnip.
3. Collections of cellular material in which are contained many multinucleated giant cells like those of a myeloma.

The development of fibrocystic tissue in the centre of the bones leads to bending or to fracture. The shaft of the humerus and the upper end of the femur are the commonest sites for these manifestations. If untreated the fractures heal very badly and the deformities progress.

Urinary symptoms: Urinary calculi are common, in the kidneys or bladder.

Pathology.—Associated with and probably resulting from a parathyroid excess. There is usually present a parathyroid tumour. There is a high blood-calcium and a high calcium excretion, and a low blood-phosphorus content and a high phosphorus excretion.

Treatment.—The association of generalized fibrocystic bone disease with high blood-calcium justifies exploration for a parathyroid tumour, which may be embedded in the thyroid gland or hidden in some recess behind the thyroid.*

LOCAL TREATMENT OF THE BONE LESIONS.—See below.

LOCALIZED FIBROCYSTIC DISEASE.

Special Features.—In this disease only one or two bones are affected. The patient is usually young, about 15 to 25. A localized cyst is associated with a spontaneous fracture. There is no change in the calcium metabolism.

Treatment.—Expose the site of the cyst, open fully and scrape out the cavity. Splint efficiently so as to prevent deformity. The most efficient kind of splint is an internal bone graft.

* Donald Hunter, *Brit. Jour. Surg.*, 1931-2, xix, 203.

OSTEITIS DEFORMANS.

(*Paget's Disease of Bone.*)

Definition.—A disease consisting in late overgrowth of the long bones, with thickening and bending.

Pathology.—The bones become softened, thickened, and lengthened. The natural curves are exaggerated by bending. The cause is quite unknown. In a few cases multiple sarcomata have grown in the affected bones.

Symptoms and Course.—Severe dull aching pains come and go, and are usually regarded as rheumatic. The onset is very insidious, and the patients live to an old age.

Deformities.—

THE CRANIUM becomes thickened and enlarged by an eccentric hypertrophy, the face remaining unaffected.

THE SPINE assumes a long kyphotic curve, with much pain and stiffness.

THE LEG BONES become bowed forwards and outwards.

Treatment.—Linear osteotomy for relief of pain.

ACROMEGALY.

Definition.—A bony overgrowth affecting chiefly the jaw, hands, and feet, and leading to gigantism.

Etiology.—Men and women are equally affected, and the disease begins in young adult life.

Pathology.—Always associated with overgrowth of anterior half of pituitary body, which may ultimately lead to death by cerebral compression. Bony changes are merely those of overgrowth.

Symptoms.—Pain is indefinite and intermittent. Headache and lassitude. Some abeyance of the sexual functions, shown by amenorrhœa in women and impotence in men. Appetite and thirst are excessive.

Signs.—The hands and feet enlarge, but more in length than breadth, the fingers becoming spatula-shaped. The jaws, especially the lower, become large, and the lips thick. Gigantism is not always present, but nearly all giants are examples of acromegaly.

NEW GROWTHS OF BONES.**Innocent.**—

FIBROMA (periosteal).

LIPOMA (periosteal).

CHONDROMA.

OSTEOMA (exostosis).

ANEURYSM BY ANASTOMOSIS.—A rare condition, found usually in the cranial bones, producing thinning of the bone over a pulsating tumour.

BLOOD CYSTS.—Found in the cancellous ends of the long bones, probably the remains of myeloid sarcomata.

SIMPLE CYSTS.—Fibrocystic disease occurs in the shafts of the long bones, especially in the humerus or femur. It causes atrophy of the bone with bending or fracture.

HYDATID CYSTS.—May occur in the long bones or the pelvic bones, arising in the medullary cavity without the formation of any parent cyst, the daughter cysts lying free. A chronic thickening of the bone occurs, later a spontaneous fracture.

MYELOMA is the commonest growth. It occurs in the lower ends of the femur and radius, and the upper ends of the tibia and humerus (i.e., the ends in which the most active growth takes place); also in other epiphyses, the lower jaw, the diploe of the skull, or as an epulis. It is generally innocent, rarely causing metastases, and not recurring after local removal. It is extremely vascular, the blood spaces often breaking down to form hæmorrhagic cysts. It often pulsates. A bony skeleton pervades the growth. Egg-shell crackling is common. (*Fig. 85.*)

Treatment.—Excision of the affected part, or scraping in early cases.

Primary Malignant Tumours: Sarcoma.—

ENDOSTEAL.—Usually grow from the cancellous tissue at the ends of the long bones. The bone is thinned, and gives the sensation of egg-shell crackling. At first a general enlargement of the bony end occurs, with less pain than in inflammatory disease. Later, fracture may occur; the soft tissues are involved last of all.

1. **ROUND- AND SPINDLE-CELLED SARCOMA** is very rapid and malignant, diffusing itself along the medulla, and containing masses of cartilage and myxomatous tissue. It quickly causes death by metastatic growths.
2. **MULTIPLE MYELOMA.**—In some cases there are multiple myeloid growths in the bones, generally the ribs or vertebrae. This is accompanied by severe pain and cachexia, and usually has a fatal result. It is accompanied by the presence of Bence-Jones's albumose in the urine.
3. **EWING'S SARCOMA.**—Usually an endosteal growth occurring in the shafts of the bones of young patients. Growth is like an endothelioma. At first the X-ray appearance resembles osteomyelitis. It causes early metastasis, but readily yields to radiation treatment by deep X rays.

PERIOSTEAL SARCOMA.—Is one of the most malignant types of tumour, causing early metastasis in the lungs and in glands. Round- or spindle-celled. Its growth is rapid and painless at first. It begins on one side of the bone and spreads outside and along it, but at the same time eats into it, and may thus cause a fracture. Some ossification usually takes place in the form of

Primary Malignant Tumours: Sarcoma, *continued*.

radiating spicules. It is very vascular and pulsating, and large veins form in the skin over it. The edge of the growth is sharply defined and craggy, distinguishing it from the ill-defined swellings of osteitis and periostitis. (*Fig. 86.*)

TREATMENT OF PRIMARY SARCOMA OF BONES.—(1) Amputation high above the disease; (2) Injection of Coley's fluid. Recurrence or metastases usually take place rapidly.

Secondary Malignant Tumours of Bone.—

CARCINOMA occurs with the more chronic forms of primary growth, especially with scirrhus of the breast and prostate, and hypernephroma of the kidney; also in the skull bones with thyroid cancer. It may cause spontaneous fracture, but with care these fractures re-unite.

SARCOMA is much rarer as a secondary manifestation, because the disease is so rapidly fatal. Spontaneous fractures due to sarcomata never re-unite.

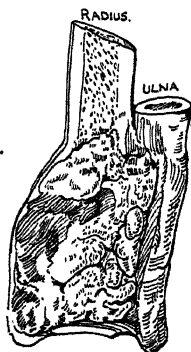


Fig. 85.—Myeloma of lower end of radius and ulna.

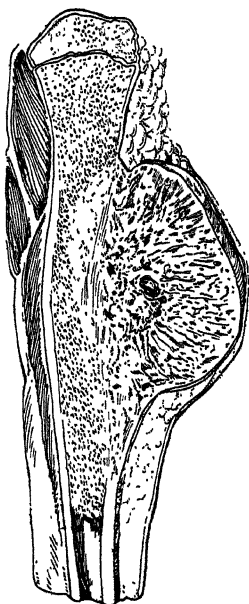


Fig. 86.—Periosteal sarcoma of tibia.

CHAPTER XXII.

THE DIAGNOSIS OF SWELLINGS CONNECTED WITH BONES.

Classification.—For diagnostic purposes bone swellings may be grouped as follows :—

1. DIATHETIC OR CONSTITUTIONAL. — Rickets — Scurvy rickets — Syphilis — Osteitis deformans — Mollities ossium — Acromegaly.
2. TRAUMATIC. — Fracture — Dislocation — Hæmatoma.
3. SIMPLE OR PYOGENIC INFLAMMATION. — Periostitis — Osteomyelitis — Abscess.
4. SPECIFIC INFECTION. — Syphilis — Tubercle — Actinomycosis — Typhoid.
5. NEW GROWTH. —
 SIMPLE. — Exostosis — Enchondroma — Fibroma — Myeloma.
 MALIGNANT. — Sarcoma (periosteal or central) — Carcinoma.
 Cysts. — Hydatid — Cysts of the jaw — Dermoids.

The Existence of a General Disease.—Rickets, scurvy, scurvy rickets, and congenital syphilis are all accompanied by manifest and unmistakable symptoms of cachexia.

THE MULTIPLICITY AND DISTRIBUTION OF THE LESIONS indicate the nature of osteitis deformans, mollities, and acromegaly.

The Evidence of Trauma.—

ORDINARY FRACTURES AND DISLOCATIONS usually give no difficulty if the cardinal signs are present and if the measurements, alteration of the relative position of bony points, and skiagram are examined.

IN SPONTANEOUS FRACTURES the trauma may have been very trivial, but in most of these cases the evidence of disunion will be clear. Evidences of tabes or other central nerve disease or of new growth should be sought for in obscure cases.

IMPACTED FRACTURES may cause bony swelling with functional disability, but none of the ordinary fracture signs. The locality (head of the humerus, lower end of radius, upper end of the femur), careful measurement, and the skiagram, make the nature clear.

FISSURED FRACTURE with a callus tumour can only be certainly recognized by the skiagram.

Evidence of Trauma in Bone Swellings, *continued*.

A HÆMATOMA connected with bone is rarely seen, except over the cranial bones in the newly-born.

A LONG INTERVAL between slight trauma and the appearance of the swelling is suggestive of tuberculous or sarcomatous growths.

The Evidence of Inflammation.—This is clear and unmistakable in all acute pyogenic infections, and indicates periostitis, osteomyelitis, or deep abscess.

THE EXISTENCE OF SEVERE CONSTITUTIONAL SIGNS points to infective osteomyelitis or periostitis.

CHRONIC INFLAMMATORY CONDITIONS present the utmost difficulty in distinguishing them from syphilitic, tuberculous, or malignant growths.

THE EXTENSIVE THICKENING OF THE SHAFT of the bone ;

THE ABSENCE OF ANY SHARP EDGE between the normal and diseased parts ;

SINUSES leading down to bare bone—are the most important characteristic features, but even these do not always distinguish chronic pyogenic from syphilitic and tuberculous cases.

The Evidence of Specific Infection.—This is often hard to obtain in chronic cases, e.g., in diffuse periostitis of syphilis.

IN CONGENITAL SYPHILIS the teeth, palate, nose, and eyes generally give definite evidence of characteristic lesions.

IN ACQUIRED SYPHILIS the history of infection or rash, and the existence of scars on skin or mucous surfaces, should be sought for.

IN TUBERCULOUS LESIONS the swelling begins near the epiphysis, and also the tuberculin and ophthalmic reactions are available. (*See* p. 64.)

ACTINOMYCOSIS rarely affects any bones but the jaws, and the granules containing the fungus afford the only proof of its nature.

TYPHOID PERIOSTITIS.—A clear history of enteric fever.

Simple New Growths rarely give much difficulty.

EXOSTOSES are sharply defined, often pedunculated, growths at the epiphyseal junction, or on certain flat bones.

ENCHONDROMATA are rare, except in the phalanges of young patients. In other situations they are rarely diagnosed from sarcomata.

FIBROMA is a slow, symptomless tumour, growing from one side of the shaft of a bone. It is very rare.

Cysts.—

DERMOIDS are recognized by their locality and by being embedded in a depression in the bone (skull or sternum).

HYDATID CYSTS may cause spontaneous fracture, and unless they exist elsewhere are not suspected.

DENTAL CYSTS affect only the jaws.

Malignant Growths.—

THE PERIOSTEAL SARCOMATA usually begin on one side of the bone and have a well-defined edge. Their growth is extremely rapid.

THE MEDULLARY SARCOMATA occur commonly in the jaw, upper end of the humerus, lower end of the radius, lower end of the femur, and head of the tibia. Great vascularity, varying consistency at different parts, and egg-shell crackling, are their most characteristic features.

The Region of the Bone affected.—

THE DIAPHYSIS is affected chiefly in: Simple and septic inflammation—Syphilitic periostitis.—Periosteal sarcoma.—Fibroma.

THE REGION OF THE EPIPHYSIS is affected chiefly in: Tubercle—Rickets—Exostoses—Central sarcoma—Abscess (osteomyelitis).

The Physical Characters of the Swellings.—

A WELL-DEFINED EDGE indicates a superficial new growth. Great chronicity, with an absence of symptoms or increase, points to this being innocent, whilst rapid growth points to malignancy.

A GRADUALLY SHELVED SWELLING indicates a chronic inflammatory or a central new growth.

EXISTENCE OF SOFT AREAS is suggestive of malignancy.

EGG-SHELL CRACKLING proves the existence of a central expanding growth, generally a myeloma, or a cystic tumour of the jaw.

MARKED VASCULARITY.—The superficial veins are large, the skin is hot, and a well-marked bruit exists in many sarcomata.

EXCESSIVE TENDERNESSE indicates an inflammatory nature.

SEVERE PAIN, especially at the onset of the disease, with a tendency to nocturnal exacerbation, is present in inflammatory swellings, both simple, pyogenic, and syphilitic. New growths are usually painless in their early stages.

Skiagraphy.—

FRACTURES AND DISLOCATIONS are evident. Fissured and impacted fractures are best demonstrated by this method.

CALLUS throws little or no shadow for several weeks after its deposit, i.e., until it has become ossified.

PERIOSTITIS.—In this there is marked thickening of the bone, which may show lamination parallel to the surface. In recent cases it is best seen at the edges of the swelling.

PERIOSTEAL SARCOMATA show spicules radiating at right angles to the bone surface. The more malignant conditions show mere bone absorption, with possibly a fracture.

CENTRAL TUBERCULOUS FOCI, GUMMATA, ABSCESS.—Exhibit a light area in the midst of the shaft or epiphysis.

CHAPTER XXIII.

INJURIES OF JOINTS.

SPRAINS.

Definition.—Subcutaneous traumatic injury of soft parts connected with a joint, i.e., of muscles, tendons, and ligaments.

Varieties.—

SPRAIN WITHOUT SWELLING.—Otherwise known as a strain. Parts have been stretched and not torn.

SIMPLE UNCOMPLICATED SPRAIN.—Muscles, tendons, or ligaments torn.

SPRAIN COMPLICATED BY A FRACTURE.

SPRAIN COMPLICATED BY A NERVE INJURY.

Symptoms.—

PAIN.—Localized—due to direct injury. Referred—due to nerve lesion.

SWELLING.—Immediate—due to hæmorrhage; may occur at a distance from injury, e.g., in ham from sprain in thigh. Late—due to inflammatory effusion.

NUMBNESS.—Temporary—due to nerve shock. Lasting more than twelve hours—due to nerve lesion.

Diagnosis.—

1. FRACTURE must be determined or excluded by X rays.
2. GROSS NERVE LESION.—Distant pain, numbness or paralysis.
3. DISLOCATION.—Alteration of relations of bony points.

Treatment.—

STRAINS, OR SPRAINS WITHOUT SWELLING.—

REST, with firm strapping.

MASSAGE begun within twenty-four hours.

VOLUNTARY MOVEMENTS as early as can be made without pain.

PASSIVE MOVEMENTS deferred till end of one week.

SIMPLE SPRAINS WITH IMMEDIATE SWELLING.—

REST, with hot fomentations until increase of swelling ceases.

Hot lotio plumbi c. opio.

ELASTIC PRESSURE with crêpe bandage or strapping.

VOLUNTARY MOVEMENTS as soon as can be used without pain.

MASSAGE within twenty-four hours of the time that the swelling ceases to increase.

PASSIVE MOVEMENTS as soon as heat subsides. Well-marked superficial hæmatoma should be incised.

SIMPLE SPRAINS WITH LATE SWELLING.—

IN SOFT PARTS.—Wait till heat disappears, then treat as above.

IN JOINTS WITHOUT HEAT AND TENSION.—Treat as above, with addition of iodides and iodine vasogen locally.

IN JOINTS WITH HEAT AND TENSION.—Aspirate—Calcium chloride to diminish effusion—Rest and hot fomentations.

When heat and tension disappear, treat as above.

TREATMENT OF SPRAINS WITH A FRACTURE.—If only fissured, and not complete fracture, treat as above.

If fracture has detached piece of bone, put up in splints.

Massage and passive movements as early as possible. Voluntary movements only when bone has set.

TREATMENT OF SPRAINS ASSOCIATED WITH GROSS NERVE LESIONS.—

For painful nerve lesions: Rest, and not massage.

For numbness: Massage, galvanism, or operation.

Remote Results of Sprains.—

PREVENTABLE.—

PAIN and STIFFNESS OF JOINTS.—The late results of immobilization and want of massage and movement.

MUSCULAR WASTING AND RELAXATION OF JOINT.—Should be prevented by massage and electricity.

DEFORMITY arises from a fracture which has been overlooked.

UNAVOIDABLE sometimes.—Osteo-arthritis—Local paralysis—

Tuberculous disease—Infective arthritis—Myositis ossificans.

MYOSITIS OSSIFICANS.—Arises in torn muscles. Slow development. Not painful. Swelling of affected muscles. Stiffness and difficulty in movement.

TREATMENT.—Prolonged rest (six months). Mass diminishes, but does not disappear.

DIAGNOSIS.—From sarcoma or periostitis.

X rays show mass in muscle away from bone. Absence of pain or heat.

DISLOCATIONS.

Causes.—

1. TRAUMATISM.—

2. CONGENITAL CONDITIONS.—

CAUSES (theoretical).—Malposition or injury in utero. Failure of one of the joint surfaces to develop, e.g., rim of the acetabulum, iliac portion of the acetabulum, head of the femur. Fœtal disease of the joint or muscles.

JOINTS AFFECTED.—Hip (common); jaw, shoulder, wrist, and patella (rare).

3. PATHOLOGICAL CONDITIONS.—May be:—

1. DISTENTION of capsule by exudation.

2. DESTRUCTION of either articular surface by disease.

3. MUSCULAR TRACTION after the destruction of ligaments.

Any of these may occur in: Acute septic arthritis (especially 1); tuberculous disease (especially 2 and 3); osteo-arthritis; Charcot's disease.

TRAUMATIC DISLOCATIONS.**Causes.—**

PREDISPOSING.—Shallow articular cavity. Lax muscles and ligaments. Adult age and male sex.

EXCITING.—Violence—generally indirect. Muscular action in lower jaw, patella, or humerus—rare except after previous dislocations.

Varieties.—

COMPLETE.—Articular surfaces are completely separated.

INCOMPLETE (subluxation).—Articular surfaces only partly separated.

COMPOUND.—External wound communicates with joint cavity.

COMPLICATED.—Associated with injury of vessels, nerves, or viscera.

Signs.—

LOCAL CONTUSION OF PARTS.—Pain—Swelling—Bruising.

RESTRICTED MOBILITY.

DEFORMITY.—Articular surfaces felt in abnormal position. Altered relation of bony points. Altered axes of bones related to the joint.

Anatomy of Dislocation.—

LIGAMENTS are torn, especially the capsular ligament.

MUSCLES torn or stretched.

TENDONS stretched, torn, or hitched round dislocated surfaces.

VESSELS and **NERVES** contused or torn.

ARTICULAR CARTILAGE fissured or torn.

BONY POINTS often fractured.

ARTICULAR CAVITY and surrounding parts are filled with blood.

OF OLD UNREDUCED DISLOCATION.—

ARTICULAR CAVITY becomes filled with fibrous tissue.

• **HEAD OF BONE** loses its articular cartilage, becomes buried in dense adhesions or surrounded by new false joint.

MUSCLES become adaptively shortened.

TENDONS acquire new attachments. Muscles, tendons, and ligaments are matted in fibrous tissue.

BONE on which movable bone rests atrophies at point of contact.

Is heaped up by periostitis round the point of contact.

If the dislocation is kept at rest for several weeks, **FIBROUS UNION** takes place.

If the dislocated limb is not kept at rest, a **FALSE JOINT** is formed.

Treatment of Dislocations.—**REDUCTION** by:—

MANIPULATION, to make the head of the bone retrace its way through the hole in the capsule.

EXTENSION, to overcome muscular tension. Preferably under an anæsthetic. Rarely with the aid of pulleys.

OPERATION.—When the above measures have failed. When fracture which prevents retention exists, e.g., forward dislocation of elbow with fractured olecranon. When fracture which prevents reduction exists, e.g., dislocated shoulder and fractured neck of humerus. When complicated by ruptured vessels or nerves.

RETENTION in position of rest.—Rest for one to three weeks according to the size of the joint. Massage and passive movement at the end of first week. Active movements in addition at the end of first, second, or third week.

DIFFICULTIES IN REDUCTION are caused by: Torn capsule embracing neck of the bone—Tonic contraction of muscles—Interlocking of bony points—Tendons and muscles catching round the neck of displaced bone.

Treatment of Old Unreduced Dislocations.—

REDUCTION should be attempted up to the end of the third month. Later than four or six weeks it is unlikely to succeed.

DANGERS.—To main vessels and nerves. Fracture of the ends of the bone. Tearing of the soft parts.

MASSAGE AND SYSTEMATIC MOVEMENTS are the best treatment: When some mobility exists—Where there is slight pain—In elderly patients.

OPEN OPERATION is indicated: When no movement is possible without pain—Especially in joints of the upper limb—Especially in young and working men.

ATTEMPT AT REPOSITION by division of tendons and adhesions.—Generally impossible because articular cavity no longer exists.

EXCISION OF THE JOINT.—Especially useful in the shoulder or elbow, where mobility is of more importance than stability.

SPECIAL DISLOCATIONS.

LOWER JAW.

DIRECTION.—FORWARDS, generally bilateral.

CAUSES.—Yawning—Gags and dental operations.

SIGNS.—Mouth cannot be shut. In unilateral cases the chin is displaced laterally. A depression occurs in front of the ear.

TREATMENT.—Pressure downwards and backwards on the lower molars by the guarded thumbs.

CLAVICLE.

Sternal End.—

VARIETIES.—

FORWARD.—The bone lies on the manubrium sterni.

BACKWARD.—Symptoms occur from pressure on the trachea, œsophagus, and vessels.

UPWARDS.—Very rare.

TREATMENT.—Draw shoulders back and fix with an 8 bandage.

Special Dislocations—Clavicle, *continued*.

Acromial End.—

VARIETIES.—UPWARDS or DOWNWARDS.

TREATMENT.—Easy to reduce, difficult to maintain. Bandage over the shoulder and under the flexed elbow. Unreduced dislocation is often of little importance. If it gives rise to pain and stiffness, treat by an open operation.

SHOULDER.

PREDISPOSING causes.—Shallowness of glenoid cavity. Laxity of capsule. Freedom of movements.

EXCITING CAUSES.—Falls on outstretched hand or elbow. Violent muscular exertion in cases that have been dislocated before.

MECHANISM.—Head of humerus tears through capsule in front or below. Subsequently displaced forwards or backwards.

VARIETIES and anatomy of each :—

1. SUBCORACOID.—Head lies below coracoid process upon the neck of the scapula (*Fig. 87*). Tendon of subscapularis is torn or stretched over the neck of the humerus. Supraspinatus, infraspinatus, and teres minor are either tightly stretched, producing external rotation, or torn (sometimes with great tuberosity), with internal rotation.
2. SUBCLAVICULAR (rare).—Exaggeration of the subcoracoid variety. The great tuberosity and coracoid process are

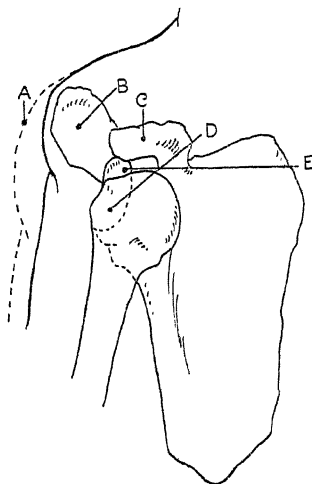


Fig. 87.—Subcoracoid dislocation of shoulder. A, Outline of normal shoulder; B, Acromion; C, Coracoid; D, Head of humerus; E, Glenoid fossa.

- fractured or their muscles are torn. Head of bone lies below clavicle.
3. SUBGLENOID (rare).—Head of bone lies on axillary border of scapula below the glenoid cavity. Muscles attached to tuberosities are torn. Axillary vessels compressed.
 4. SUBSPINOUS DISLOCATION.—Head rests on the posterior aspect of the neck of the scapula. Subscapularis muscle is torn.
 5. SUPRACORACOID (very rare).—Acromion (and possibly coracoid) fractured. Head of the bone tears through upper part of capsule.
 6. LUXATIO ERECTA (very rare).—Head of bone lies below glenoid cavity. Arm is stiffly held above the head. Rotator muscles are intact.

SIGNS OF DISLOCATION.—

LOCAL CONTUSION.

RESTRICTED MOBILITY.

FLATTENED OUTER BORDER OF SHOULDER.—Straight edge can touch acromion and external condyle.

HEAD OF BONE is felt in an abnormal position.

ELBOW DISPLACED from the side, and cannot touch the chest wall when the hand is on the opposite shoulder.

VERTICAL MEASUREMENT round the axilla is increased.

ANTERIOR OR POSTERIOR FOLD of the axilla is lowered.

MEASUREMENTS.—From acromion to external condyle is customarily unaltered, but there may be slight shortening, especially in the subclavicular. In the subglenoid variety there is an inch lengthening.

SPECIAL SIGNS of the different varieties :—

SUBCORACOID.—Head felt below outer end of the clavicle. Elbow is directed outwards and backwards. Shortening absent or very slight.

SUBCLAVICULAR.—Head felt below middle of the clavicle. Shortening may be present. Elbow is far from the side.

SUBGLENOID.—Head is felt in the axilla. Signs of pressure on vessels and nerves. Marked lengthening of the arm. Flexion of elbow from tension on biceps.

SUBSPINOUS.—Head of the bone felt behind, below the acromion. Elbow displaced forwards. Arm rotated inwards.

TREATMENT OF SHOULDER DISLOCATIONS.—

1. MANIPULATION under anæsthetic.

Kocher's Method.—Elbow is held to the side. Hand is brought forwards and outwards, so as to rotate the humerus externally and relax the external rotators. Elbow is adducted to the mid-line—this makes the margins of the gap in the capsule tense. Elbow is raised, so as to slacken upper margin of the rent and keep lower tense. Hand is placed on the opposite shoulder, i.e., arm is rotated inwards, to make the head of the humerus slip into the capsule. Elbow lowered.

Special Dislocations—Shoulder—Treatment, *continued*.

2. EXTENSION.—Traction on the hand whilst counter-extension is made in the axilla by the heel of the operator.

Recurrent Dislocation.—The shoulder after simple dislocation is very liable to recurrence of the displacement owing to laxity and weakness of the capsule and shoulder muscles.

TREATMENT.—(1) By forming a muscle sling. The anterior and posterior borders of the deltoid are exposed; a strip from the posterior border is brought under the joint and sewn in front. (2) A similar exposure, but using a long strip of fascia lata. The ends of the latter are fastened over the acromion. (3) By an axillary exposure. The torn or stretched capsule is exposed below the subscapularis tendon. The capsule is repaired by suture or fascial grafting.

ELBOW.

VARIETIES.—BACKWARDS—FORWARDS—LATERAL.

BACKWARD DISLOCATION (the common variety).—The coronoid process is often broken. The distance from the acromion to the condyles is unaltered. The distance of the olecranon from the condyles is increased. The distance of the condyles from the styloid processes is less. The olecranon is unduly prominent. The arm is held flexed.

FORWARD DISLOCATION (rare, except as a complication of fractured olecranon).—Forearm is markedly lengthened.

Condyles are unduly prominent. The olecranon is obscured.

LATERAL DISLOCATIONS are very rare and usually incomplete.

TREATMENT.—Flexion of the forearm over the operator's knee placed in the bend of the elbow.

The Ulna Alone (very rare).—BACKWARD.

The Head of the Radius.—

VARIETIES.—COMPLETE—FORWARD (the common variety)—BACKWARD or OUTWARD (very rare)—INCOMPLETE—SUBLUXATION.

FORWARD DISLOCATION.—Prominence of the head of the radius in front of elbow. Hollow behind the external condyle. Flexion at the elbow is incomplete. Supination is defective. Easy to replace, difficult to retain owing to the rupture of the orbicular ligament.

TREAT by flexing with a pad in the elbow. Keep flexed for two or three weeks. Massage and passive movements at end of seven days.

SUBLUXATION ('pulled elbow').—The radial head is pulled downwards out of the orbicular ligament. The arm is fixed in a partly flexed position. Results in children from their being lifted up by one hand.

TREAT by complete flexion and then extension.

WRIST.

VARIETIES.—BACKWARDS (rare)—FORWARDS (very rare).

SIGNS.—Both styloid processes project prominently, but their relation to each other is normal. The carpal bones form a mass at the back of the joint, and their relations to the styloid processes are altered.

FIRST PHALANX OF THUMB.

DIRECTION.—BACKWARDS.

ANATOMY.—The head of the metacarpal becomes entangled by :

- (1) The tendon of the long flexor ;
- (2) The glenoid ligament, i.e., the capsule of the joint ;
- (3) The short muscles attached to the sesamoid bones.

REDUCTION.—By traction followed by flexion. Is often very difficult. In this case open the joint behind and cut the glenoid ligament at its attachment to the base of the phalanx.

HIP.

ANATOMICAL FACTORS.—

The ilio-femoral ligament is the strongest part of the capsule.

It is usually unruptured, the dislocation in this case being one of the regular varieties. If it is torn, the dislocation will be irregular.

The tendon of the obturator internus runs over the neck of the femur behind. In backward dislocations its integrity will prevent the femoral head going up to the dorsum ilii.

The rim of the acetabulum, especially above and behind, may be chipped off ; this makes retention after reduction very difficult.

The capsule is usually torn below or behind at its weakest place.

VARIETIES.—BACKWARD : (1) On to the dorsum ilii ; (2) On to the sciatic notch. FORWARD : (3) On to the obturator foramen ; (4) On to the pubis.

DORSAL DISLOCATION.—Head of femur lies on the dorsum ilii, and can be felt in the buttock. The obturator internus is ruptured in most cases. The short rotator muscles are lacerated. The trochanter lies well above Nélaton's line, and approximated to the anterior superior iliac spine. The leg is shortened two to three inches. The iliotibial band is relaxed. The leg is flexed, adducted, and inverted. The femur crosses the lower third of the opposite thigh. The toe rests on the opposite instep. A hollow exists in Scarpa's triangle.

SCIATIC DISLOCATION.—Similar to the above, except in the following : The obturator internus tendon is intact and lies over the neck of the femur, holding it down in the sciatic notch. Shortening amounts only to one inch or less. The axis of the femur crosses the opposite knee. The great toe rests on the dorsum of the opposite great toe.

Special Dislocations—Hip, *continued*.

TREATMENT OF THE BACKWARD DISLOCATIONS.—

MANIPULATION.—Flex the knee and thigh in position of adduction. Abduct the thigh and evert simultaneously. Bring the leg down straight. "Lift up, bend out, roll out."

DIRECT TRACTION of the thigh forwards in a line at right angles to the body.

OBTURATOR DISLOCATION.—The head of the bone lies on the obturator externus in the obturator foramen. The adductor muscles are lacerated. The trochanter is obscured, the iliotibial band is tense. The leg is lengthened, the toes point forwards and outwards. Flexion, abduction, and rotation outwards are well marked. The head of the femur is felt in the perineum. The capsule is torn in its lower part. Pain referred to the distribution of the obturator nerve.

PUBIC DISLOCATION.—Similar to the above, except: The femoral head is felt under Poupart's ligament. The leg is shortened about one inch. Abduction and eversion are more marked, the toes pointing outwards.

TREATMENT OF FORWARD DISLOCATIONS.—Thigh is flexed in a position of abduction. Adduct the thigh and then invert it. Bring the thigh down straight. "Lift up, bend in, roll in."

Congenital Dislocation of the Hip (*see also* p. 255).—

SYMPTOMS.—

Child begins to walk late. Deformity is noticed only after walking has begun. Gait is waddling and rolling from side to side.

Buttocks are very prominent behind. Hips are very broad laterally. Belly is very protuberant.

Marked lordosis is always present. Scoliosis is evident in unilateral cases.

Heel is not brought to the ground on affected side.

POSITION OF LEG.—Thigh is flexed (by traction of iliopsoas), adducted (by traction of adductors), slightly inverted (by traction of the anterior part of the capsule).

Shortening of one to three inches.

Trochanter is much above Nélaton's line, and may be at the level of iliac crest; it is farther from the mid-line than normal.

A gap occurs in the perineum between the thighs.

TRENDELENBURG'S SIGN (also given in paralysis affecting the glutei groups).—When walking and stepping on the affected leg, the opposite side of the pelvis drops, instead of being raised.

POSITION OF THE PELVIS.—Flexed on the thigh by traction on iliopsoas; consequent great lordosis. Often tilted laterally in unilateral cases.

MOBILITY.—Free mobility, except in abduction. Limb can be drawn down to its full length by traction in the flexed position, especially in early cases.

PAIN.—Usually absent. Fatigue and aching after walking.

Recurrent synovitis is common.

Passive movements are painless.

IN UNILATERAL CASES.—Waddling and rolling are not so marked. Lameness is much less conspicuous. Scoliosis of lumbar region occurs, with convexity on lame side. There is a difference of one to three inches in the length of the two legs.

SKIAGRAM.—Trochanter is on a level with anterior superior iliac spine. Acetabulum is deficient in its iliac segment. Head of the femur is absent or malformed. The angle between the neck and shaft is more open than normal (coxa valga). A ridge of new bone may jut out from the dorsum ilii above the femur, representing the false acetabulum.

PATHOLOGICAL ANATOMY.—

ACETABULUM.—Iliac segment is deficient. Cartilaginous rim is absent. It consists of a triangular shallow depression at union of pubis and ischium (*Fig. 88*).

FALSE ACETABULUM.—In old cases that have walked, a rim of new bone may be present on the dorsum ilii, forming a new acetabulum.

HEAD OF THE FEMUR is stunted or absent. The neck is short.

CAPSULE is lengthened and thickened. It presents a well-marked hour-glass contraction, which after 5 or 6 years is too tight and too strong to permit the head of the bone being pushed through it into its socket (*Fig. 89*).

LIGAMENTUM TERES is long and band-shaped, or absent.

DIAGNOSIS from:—

COXA VARA.—Comes on in childhood or puberty after child has walked well. Eversion. Limb cannot be lengthened by traction. Skiagram shows deformity of neck.

TUBERCULOUS HIP.—Late onset of symptoms. Pain is much more marked. Rigidity of the joint. Limb cannot be pulled down.

TRAUMATIC DISLOCATION.—History of difficult labour. Limb cannot be pulled down. Skiagram shows normal bones.

TREATMENT.—

IN EARLY CASES (UP TO 6 YEARS).—

Lorenz' Bloodless Operation.—Limb is pulled down, flexed, abducted, and everted. Adductors are ruptured by kneading. Fixed by plaster bandage, including pelvis and thigh: position of extreme abduction and slight eversion. Retained for twelve weeks. Fixed again with less abduction for six months.

IN OLDER CASES.—Open operation. An incision along crest of ilium and down along line of sartorius. All tissues separated from outer surface of ilium, and acetabulum exposed. Capsule opened and hour-glass constriction divided. Head of bone levered into position. If the

Congenital Dislocation of the Hip—Treatment, *continued*.

socket is too shallow to retain the head, then the upper margin of the acetabulum must be increased by turning down a bone flap from the outer surface of the ilium or wedging in a bone graft.

IN ADULT CASES.—An osteotomy just below the small trochanter. The shaft of the femur is fully abducted. This causes the pelvis to be tilted down on the affected side, thus making the limb so much longer. The pelvis is supported on the crooked femur instead of hanging on the capsule. This cures the pain.

PATELLA.

VARIETIES.—OUTWARDS, INWARDS, or VERTICAL ROTATION.

Genu valgum or varum are predisposing causes. Muscular violence or direct violence may cause it.

Accompanied by a rupture of a part of the extension of the quadriceps aponeurosis.

TREAT by flexing the thigh, extending the knee, and pressing into place.

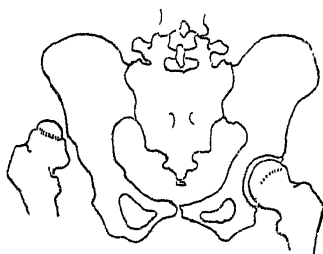


Fig. 88.—Tracing of congenital dislocation of right hip in a girl of 3 years. Note the shallow acetabulum in comparison with the normal left side.

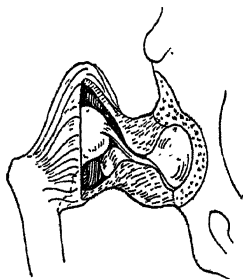


Fig. 89.—Diagram showing hour-glass constriction of capsule in section.

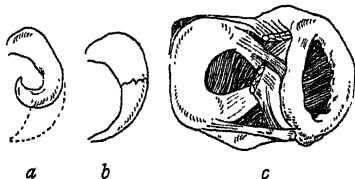


Fig. 90.—Three common varieties of rupture of the internal semilunar cartilage of the knee. *a*, Rupture of anterior coronary ligament. *b*, Transverse rupture. *c*, Longitudinal rupture; deep portion displaced towards centre of joint ('bucket-handle' rupture).

RECURRENT DISLOCATION is nearly always outwards, and is associated with genu valgum. It is treated by operative correction of the genu valgum, in addition to which one of the muscles on the inner side of the knee, e.g., the gracilis or semitendinosus, is attached to the inner border of the patella.

KNEE.

VARIETIES.—BACKWARD, FORWARD, LATERAL. Usually incomplete.

DIAGNOSIS is obvious from the deformity.

RUPTURE OF SEMILUNAR FIBROCARILAGE.

CAUSES.—Violent rotation of the body standing on one leg, as, e.g., when a violent kick is missed. Any sudden twist of the slightly bent knee.

ANATOMY.—

NORMAL.—Both cartilages are attached to the tibia by (1) their two extremities, (2) short vertical ligaments—the coronary ligaments—to the edges of the tuberosities. The internal cartilage is semicircular, it is firmly attached to the capsule of the joint and to the internal lateral ligament. The external cartilage is nearly circular; the greater part of its edge is separated from the capsule by the tendon of the popliteus muscle. Hence the internal cartilage is more fixed, the external more mobile.

IN RUPTURE.—The internal cartilage is affected twenty times more often than the external. The reasons for this are:—

1. The greater fixity of the internal cartilage.
2. The fact that normal slight rotation of the knee-joint takes place round the external condyle as a pivot, the internal tuberosity and cartilage moving, whilst the external are stationary.

The cartilage or its ligaments are torn in one of the following ways:—

1. One or both extremities from the tibia.
2. The edge from the capsule and internal lateral ligament.
3. The coronary ligament from the tibia (*Fig. 90*).
4. The cartilage divided into two pieces, either across or parallel to its long axis (*Fig. 90*).
5. The internal lateral ligament itself is often partly torn.
6. A part of the cartilage may be torn right off to form a loose body.

The torn cartilage becomes displaced, so as to be locked between the joint surfaces or in the intercondyloid notch. Synovial effusion with synovitis results.

LATE CHANGES IN THE JOINT.—The torn cartilage and ligaments become converted into fibrocartilaginous tags or loose bodies in the joint. Chronic synovitis is caused by repeated attacks

Rupture of Semilunar Fibrocartilage of Knee—Anatomy, *continued*.

of synovial effusion following a locked joint. The ligaments become relaxed and weakened. The synovial membrane becomes thickened and its free edges converted into fibrous fringes.

SIGNS AND SYMPTOMS.—Violent pain in the knee-joint, chiefly on the inner side over the lateral ligament.

The knee is locked in a semi-flexed position.

Synovial effusion with its usual signs appears within a few hours.

Later, and in the absence of proper treatment, recurrent attacks of synovitis often occur in any action of flexion and rotation of the knee.

Tenderness is most marked on pressure over the tibial attachment of the internal lateral ligament.

Very rarely a lump or gap can be felt in the position of the cartilage.

TREATMENT.—

REDUCTION by flexion and extension of the joint.

IMMOBILIZATION on a back splint for six weeks, followed by firm bandaging for three months. This treatment should be adopted in all recent cases occurring for the first time.

OPERATION (for all recurrent cases).—If thorough immobilization has been neglected at first, it is useless later. Incision in a transverse direction over the edge of the affected cartilage. Open the joint. Remove completely all injured or displaced parts of the cartilage. Cut any tags of hypertrophied synovial membrane. Close without drainage.

RETENTIVE APPARATUS (when operation is refused or undesirable in chronic cases).—The mechanism embraces the joint, and whilst allowing flexion does not permit of any rotation.

DIAGNOSIS.—

Loose Body in the Joint.—In this the symptoms and signs are similar, but the pain is not so lasting, locking does not occur, and effusion is not so marked.

The Nipping of Synovial Fringes in the joint.—In this the thickened synovial membrane can often be felt. There is some history relating to the onset and cause of chronic synovitis.

The diagnosis between these three conditions can often only be made after the joint is opened.

RUPTURE OF THE CRUCIAL LIGAMENTS.

Usually the result of great direct violence producing partial dislocation.

RUPTURE OF THE ANTERIOR LIGAMENT.—This ligament, which is attached to the external condyle of the femur and to the

front of the tibia, is tense during extension of the knee. When ruptured the tibia slips forward on the femur.

RUPTURE OF THE POSTERIOR LIGAMENT.—This ligament, which is attached to the inner condyle of the femur and to the back of the tibia, is tense during flexion of the knee. Its rupture is accompanied by a backward displacement of the tibia on the femur.

TREATMENT.—(1) Cage splint hinged at the joint. (2) Open operation with suture of ligaments. (3) Replacement of torn ligaments by stout silk strands. (4) Replacement of torn ligaments by fascia or tendons. A strip of fascia lata is threaded through the external condyle and head of tibia for the anterior ligament, and the semitendinosus and gracilis tendons through the head of the tibia and internal condyle for the posterior ligament.

ANKLE.

FOOT MAY BE DISLOCATED: (1) At the ankle-joint, with or without fracture; (2) At the astragalo-calcanean joint.

ASTRAGALUS MAY BE DISLOCATED from between the tibia and the os calcis.

DISLOCATION OF ANKLE-JOINT.

VARIETIES.—

OUTWARDS (the commonest) or **INWARDS**—always combined with Pott's fracture.

UPWARDS (the rarest)—generally with Dupuytren's fracture

BACKWARDS or **FORWARDS**—generally without fracture.

BACKWARD DISLOCATION.—Both lateral ligaments or both malleoli ruptured. Heel projects backwards. Distance from malleoli to heel is increased. Distance from malleoli to toe is diminished.

FORWARD DISLOCATION.—Structures ruptured as above. Heel is much shortened. Distance from malleoli to heel is diminished. Distance from malleoli to toes is increased.

UPWARD DISLOCATION.—Lateral and interosseous ligaments are torn. Malleoli are widely separated. Shortening of the leg.

TREATMENT.—Reduction and fixation as in Pott's fracture. Massage and passive movements from third day.

DISLOCATION OF THE ASTRAGALUS ALONE.

VARIETIES.—

FORWARD.—Generally forwards and outwards. May be forwards and inwards.

BACKWARD.

ROTATION on a sagittal axis, combined with forward or backward displacement.

Generally incomplete—rarely complete.

Dislocation of the Astragalus alone, *continued*.

SIGNS.—Prominence of the astragalus is felt on dorsum of the foot in forward dislocations—Above the heel in backward dislocations.

Distance of malleoli from back of heel and from toes is not altered.

Distance of malleoli from sole may be lessened.

TREATMENT.—Manipulation under anæsthetic with knee flexed.

In complete cases or irreducible incomplete cases, open operation—Replace or remove the astragalus.

SUBASTRAGALOID (ASTRAGALO-CALCANEAN) DISLOCATION.

VARIETIES.—

BACKWARDS (generally).—Backwards and inwards, or backwards and outwards.

FORWARDS (very rare).

SIGNS of the ordinary backward dislocations.—

Head of astragalus is prominent on the dorsum. Skin may be burst by the tension.

Distance from malleoli to heel is increased. Distance from malleoli to toes is decreased.

Foot is plantar-flexed, and inverted like equinovarus, or everted like equinovalgus.

TREATMENT.—Reduction under anæsthetic.

Open operation is necessary if reduction is impossible. Free the tibialis anticus and posticus tendons from neck of the astragalus. If this fails to reduce, excise the astragalus.

CHAPTER XXIV.

DISEASES OF JOINTS.

INFLAMMATION OF JOINTS.

ACUTE SYNOVITIS.

Causes.—Injury, e.g., sprain or dislocation—Rheumatism and gout—Syphilis and gonorrhœa—Pyæmia.

Anatomy.—Synovial membrane is hyperæmic. Plasma and cells exude (1) into the membrane, (2) into the joint. Membrane is thickened and red. Endothelium may be shed.

Fluid in joint is increased—May be blood-stained.

Lymph is deposited on the articular surfaces.

If the endothelial surface has been destroyed, as it generally is in septic cases, a plastic fibrocellular exudation takes its place. This subsequently becomes organized into adhesions. If the inflammation is severe, the ligaments become softened and relaxed.

If the cause is simple and not septic, the exudation becomes absorbed, with little or no adhesions, except where cartilages or ligaments have been torn.

Signs.—

INFLAMMATION.—Heat, redness, swelling, and tenderness.

JOINT IS FIXED by muscular spasm. Position of ease assumed; generally slight flexion. Active and passive movements are equally painful.

SYNOVIAL EFFUSION causes a fluctuating swelling, of characteristic shape. Muscles round joint atrophy (in severe and septic cases). Pain is not felt when the part is at rest. Absence of tenderness on pressing the bony points.

Diagnosis.—

IN ARTHRITIS there are pain and swelling of bony ends. Pain is worse in active than passive movements. Grating shows destruction of cartilage.

IN TUBERCULOUS DISEASE.—Original injury absent or trivial—Slow onset—Muscular wasting marked—Inflammation slight or absent—Synovial swelling is pulpy, rather than fluid—May be signs of bone affection as in arthritis—Reaction to tuberculin.

IN SPRAINS.—Violent trauma—Immediate swelling—Marked ecchymosis.

IN HÆMOPHILIA.—History of bleeding and bruising—Rapid swelling after trivial injury—Comparatively painless—May be signs of creaking and grating.

Diagnosis of the Nature of Acute Synovitis.—(See ACUTE ARTHRITIS, p. 273.)

Treatment.—

1. Immobilization of joint, when effusion is increasing and inflammation is present.
2. Firm bandaging.
3. Aspiration or leeches if great tension exists.
4. Ice or evaporating lotions in early stages. Hot fomentations to relieve pain after twenty-four hours.
5. Massage and passive movements to be used directly the swelling ceases to increase, and when the inflammation has gone.
6. Active movements as soon as they can be done without pain.
7. If adhesions exist so as to prevent movement, treat by weight extension until inflammation disappears. Move under anæsthetic if no inflammation exists.

CHRONIC SYNOVITIS.

Causes.—Previous acute attack. Causes of acute synovitis acting in a slight degree. Chronic irritation in joint (ruptured or displaced cartilage, loose cartilage, torn synovial fringes, foreign body). Want of tone in muscles and vessels, e.g., after rising from long confinement to bed.

Anatomy.—Great distension of capsule. Stretching of ligaments. Distension of bursæ communicating with the joint. Thickened synovial membrane, the free edges of which are often produced into hypertrophied villous fringes. The cartilage is often rough and fibrillated.

Signs.—Characteristic swelling. Weakness in the joint. Easily fatigued. Little or no pain.

Diagnosis of chronic synovitis to be made from other conditions producing HYDROPS ARTICULI, viz.:

OSTEO-ARTHRITIS.—Marked grating—Several joints generally affected—Lipping of the cartilage rim.

CHARCOT'S DISEASE.—As in the last, with signs of tabes or syringomyelia.

TUBERCULOUS SYNOVITIS.—Very rare as a hydrops—Absence of adequate cause—Marked muscular wasting—Tuberculous reaction.

SYPHILIS (secondary) and GONORRHOEA.—The diagnosis rests on a discovery of the original disease.

Treatment of Chronic Synovitis.—

1. Fix the joint, and apply firm pressure, with counter-irritation by blisters.
2. Try systematic massage, with hot-air baths.
3. Aspiration, with pressure and rest.
4. Open the joint. Remove foreign body or synovial fringes. Wash out with sterilized water.

BAKER'S CYSTS.

Definition.—Cysts originating from synovial pouches connected with joints.

Causes.—Chronic synovitis—Bursitis of bursæ connected with joints—Osteo-arthritis—Tuberculous synovitis.

Anatomy.—Synovial sac buried in muscles and fasciæ. Connected to joint by a stalk which has an open communication with the joint, but this may become closed later (*see Fig. 41, p. 185*).

Signs.—Fluctuating swelling in the neighbourhood of a joint. The swelling can in some cases be reduced into the joint. The joint itself usually shows signs of chronic synovitis.

Treatment.—Excision if they cause pain.

ACUTE ARTHRITIS.

All the joint structures are inflamed, i.e., synovial membrane, ligaments, cartilages, and bones.

Causes.—

SEPTIC INFECTION.—(1) By wounds; (2) By blood-stream (infective arthritis), streptococcal.

EXTENSION from infective osteomyelitis: especially in syphilitic infants. Generally staphylococcal.

SPECIFIC FEVERS.—Measles and scarlet fever (streptococcal infection)—Enteric (*B. typhosus*)—Pneumonia (*Pneumococcus*)—Gonorrhœa (*Gonococcus* or mixed infection)—Rheumatism (doubtful organism)—Pyæmia.

Symptoms.—Synovial distention. Fixation of joint by muscular spasm. Slight flexion of joint.

PAIN.—Acute tenderness. All movement is impossible. Active movement is worse than passive. Starting pains when patient falls asleep.

SIGNS OF ACUTE INFLAMMATION.—Heat, redness, and œdema. ABSCESS formation in the neighbourhood of joint. Abscesses burst and leave sinuses, leading to dead bone.

SEVERE TOXIC FEVER.

DISLOCATION occurs at a later date when the ligaments have given way.

Terminations.—

RECOVERY with a movable joint: only possible in cases treated very early.

DISLOCATION following disorganization.

ANKYLOSIS, fibrous or bony.

DEATH from septicæmia or pyæmia in acute stage, or secondary hæmorrhage; lardaceous disease later.

Acute Arthritis, *continued*.

Anatomy.—

SYNOVIAL MEMBRANE is acutely inflamed.

The exudation from the blood-vessels, instead of forming plastic lymph, is killed by bacterial toxins and forms pus. The endothelium and then the deeper layers are destroyed by this suppurative inflammation.

The surface of the synovial membrane is eventually replaced by granulation tissue.

LIGAMENTS become softened by inflammatory infiltration. Those which are surrounded by synovial membrane (e.g., ligamentum teres in hip, or crucial ligaments in knee) soon disappear, digested by the proteolytic action of leucocytes and bacteria. Others stretch or are ulcerated through.

CARTILAGE.—Colour changes to dull opaque yellow. It is eroded irrespective of pressure points. It is raised in flakes from the bone by inflammatory processes creeping from the edges or through perforations in its surface. Ultimately the cartilage is almost entirely replaced by granulation tissue which springs from the bone beneath, and from the surrounding zone of granulations which have replaced the synovial membrane.

BONE.—The articular surfaces become bare of cartilage. Acute osteitis occurs. The bony tissue is absorbed by osteoclasts. The vessels and cellular elements increase, thus producing osteoporosis and caries. Areas of necrosis occur.

THE PERIOSTEUM is acutely inflamed, but extensive necrosis does not occur, because the bony ends have an independent blood-supply.

In chronic cases which survive the acute stage, stalactiform masses of new bone are produced by the inflamed edge of the periosteum.

THE JOINT CAVITY is first filled with turbid serum; then with pus, and flakes of necrosed cartilage. Is later lined by granulating surfaces which replace the synovial membrane and cartilage. The granulations coalesce and become organized into dense fibrous adhesions.

Treatment.—

1. IN EARLY, MILD, AND DOUBTFUL CASES.—

REST, and

BIER'S CONGESTIVE TREATMENT.—A rubber bandage is wound round the limb at some distance above the joint, sufficiently tight to obstruct venous and lymphatic return, without producing coldness or loss of pulse. Kept on for twenty hours out of twenty-four. Limb is elevated during the interval. It makes the whole limb fiery red and very swollen and oedematous. It relieves the pain at once. Produces resolution without suppuration in many cases.

2. IN CASES WITH PUS, BUT BEFORE THE ARTICULAR SURFACES HAVE BEEN DESTROYED.—Free incisions are made into the joint and the cavity washed out. Wounds are partially closed and a drain taken down to, but not into, the synovial cavity. Active movement is encouraged, as this promotes drainage.
3. IN CASES WHERE DESTRUCTION OF THE ARTICULAR SURFACE HAS PROBABLY OCCURRED.—Immobilization in best position for ankylosis. (Knee: 5° flexion. Hip: 30° flexion and slight abduction. Shoulder: 40° abduction. Elbow: At angle of 135°, and midway between supination and pronation. Wrist: Dorsiflexion. Foot: At right angles and slight inversion.) Weight extension prevents starting-pains.
 Open the joint freely. Irrigate with sterile salt solution.
 Drain.
 Bier's congestive method should be applied after the operation, and greatly hastens recovery.
 Change the dressings frequently, with irrigation.
4. AMPUTATION may be required: In toxæmia threatening life—In secondary hæmorrhage—In chronic suppurating sinuses.
5. EXCISION may be required: For ankylosis in a faulty position.

SPECIAL FORMS OF ACUTE ARTHRITIS.

Rheumatic.—Generally a synovitis only. Complete recovery without ankylosis is the rule. One joint after another is attacked.

Occasionally arthritis of one or more joints occurs. Ankylosis without suppuration results.

Chronic synovitis is sometimes left. Synovial membrane becomes pulpy. Adhesions produce fibrous ankylosis.

Recovery may occur after a long time.

Salicylates are most useful in acute cases.

Acute arthritis resisting salicylates should be opened and washed out.

Gouty.—Generally attacks big-toe joint first. Attack begins suddenly in the night. Part is red, cedematous, and very tender. Seldom affects women. Small rather than the large joints are affected. Leads to changes of osteo-arthritis.

CAUSED by a deposit of biurate of soda in the cartilage, ligaments, and fibrous tissue of the joint.

ASSOCIATED with uratic tophi round the joints and in the ears.

TREATED by hot fomentations in the acute stage, and lithia, colchicum, and alkalis in the chronic.

Pyæmic.—The joints become rapidly distended with pus. Marked absence of pain.

TREAT by opening, washing, and draining.

Use of appropriate vaccine.

Acute Arthritis—Special Forms, *continued*.**Enteric.—**

1. Simple synovitis, probably toxic rather than microbic.
2. True typhoid arthritis, producing destruction of ligaments and dislocation without suppuration. Tends to spontaneous recovery.

TREAT by maintaining good position. Opening if the effusion becomes great.

3. Mixed or pure pyogenic infections. Symptoms and treatment as for acute arthritis in general

Pneumococcal.—Occurs as a complication of pneumonia, and less frequently of pneumococcal meningitis or peritonitis.

IN ADULTS.—

JOINT INCIDENCE.—Upper limb rather more frequently affected than the lower. The knee much more often than any other joint. In two-thirds of the cases only one joint is affected; in about one-third, two or more suffer at once.

ANATOMY.—About 90 per cent suppurate, and the remainder present a sterile synovitis. Three conditions may thus be found.

1. A serous synovitis—the rarest.
2. A purulent arthritis with thick flakes of lymph and clear fluid.
3. A purulent arthritis with thick or thin pus.

The pneumococci are found on the surface of the exudate. The cartilages are eroded and the ligaments destroyed in the acute cases, and if the patient lives, an extra-articular abscess forms. There is little tendency to bone destruction.

PROGNOSIS.—About 70 per cent of cases die from the toxæmia. **TREATMENT.**—Incision and drainage. The functional results are good if the patient lives.

IN CHILDREN.—

ETIOLOGY.—It may be a primary infection of the joints, or more often is secondary to otitis media.

ANATOMY.—Destructive joint changes are less marked than in the adult form.

SYMPTOMS.—An irregular fever, with comparatively indolent swelling of the joint, are the chief features. Sleep is undisturbed, and the child may eat well.

SIGNS.—The skin is pale, and there is a diffuse œdema round the joint, extending, it may be, over the whole limb. There are tenderness and increased heat, but little redness. Some cases may resolve without suppuration.

TUBERCULOUS DISEASE OF THE JOINTS.**Etiology.—**

PREDISPOSING CAUSES.—Hereditary disposition (of slight importance). Injury to the joint by trauma or other forms of synovitis. Any condition of general debility.

EXCITING CAUSE.—The entrance of the tubercle bacillus. Sometimes this evidently comes from some other primary focus, but more often not.

AGE.—Patients of any age may be affected. Children and growing adults are the most susceptible, because the young cells of the growing parts of the bone form suitable tissue for the development of the disease. Old people are rather more susceptible than middle-aged, because of their lowered vitality.

POOR PEOPLE are specially liable, because of their bad food, defective hygiene, and the neglect of trivial injuries.

Pathology.—The disease primarily affects either the synovial membrane or the ends of the bone. The cartilages and ligaments are affected only secondarily.

SYNOVIAL CHANGES.—

INFILTRATION AND DEGENERATION.—Pulpy swelling caused by oedematous thickening of the membrane, which is studded by early tubercles. Caseation of some of the tuberculous foci, which break into the joint or surrounding structures. Suppuration (in the tuberculous sense). This occurs only in some cases; in those treated early the disease never goes beyond the pulpy thickening or caseation. When it does occur, a condition like that of a chronic abscess is set up, the synovial membrane being replaced by a fibrous layer lined by granulations exuding tuberculous pus.

REGENERATION AND REPAIR.—The caseous foci become cretified or encapsuled by fibrous tissue. The granulations are converted into fibrous tissue. Opposed granulating surfaces grow together to form fibrous adhesions.

EXTENSION always takes place to some of the other tissues.

LIGAMENTS are attacked, softened, and destroyed very early, because the synovial membrane is so closely related to them.

CARTILAGES are invaded by the thick edge of membrane creeping over them and the disease spreading under their edges.

BONES are attacked first under the edges of the articular cartilages, and when the latter have been destroyed, directly from the joint disease.

BURSÆ which are connected with the synovial cavity are infected, and in chronic cases may form 'Baker's cysts'.

THE CAVITY OF THE JOINT is first distended with synovial fluid, but a true hydrops articuli of tuberculous origin is rare.

THE PULPY MEMBRANE may be greatly hypertrophied and form fringes which fill up the folds of the joint, and may cause loose bodies from a separation and fibrous thickening of the free extremities.

Tuberculous Disease of Joints—Pathology, *continued*.

BONE CHANGES.—

POINT OF ORIGIN.—(1) Beneath the articular cartilage; (2) In the epiphysis next to the growing cartilage; (3) In the diaphysis next to the growing cartilage (this is rare, except in the neck of the femur).

NATURE.—Tuberculous invasion of the cancellous tissue. Rarefying osteitis or caries of the bone. Necrosis of small islands of bone between or in carious foci. Osteosclerosis or reparative osteitis round the outer margin of disease tends to limit its spread. The usual tuberculous events of caseation or suppuration accompany its development.

SPREAD.—Under the edges of the articular cartilage into the joint. Through the articular cartilage into the joint. Through the epiphysal cartilage into the shaft. Through the compact bone of the neck into the tissues outside the joint.

MARGINAL OUTGROWTH of spicules of new bone takes place to a slight degree (*see* CHANGES IN THE PERIOSTEUM).

CHANGES IN THE CARTILAGES (*see* Fig. 91, p. 291).—These are always secondary to synovial or osseous disease.

PRIMARY BONE DISEASE beginning under the articular cartilage causes their earliest and most complete destruction.

ATTACKED FROM THEIR DEEP SURFACE, by the tuberculous granulations in the bone, the latter fungate through them, or more rarely separate off flakes as loose bodies in the joints.

ATTACKED FROM THEIR SUPERFICIAL SURFACE, as in synovial disease, they become eroded by the overlying tuberculous granulations from their edges towards their centres, and finally quite replaced by this granulating surface.

CHANGES IN THE LIGAMENTS.—The ligaments also are only secondarily affected, and especially in synovial disease. They are attacked and replaced by tuberculous tissue. They then quickly become soft and disappear.

Ligaments surrounded by synovial membrane will suffer early and completely, because they are attacked on all sides, e.g., the ligamentum teres of the hip, or the crucial ligaments of the knee.

This destruction of the ligaments allows pathological dislocation to take place by the action of gravity or of muscular tension.

CHANGES IN THE PERIOSTEUM.—This is not as a rule much affected, because it ends at the junction of epiphysis and diaphysis outside the area of disease. It may become inflamed and form new spicules of bone like stalactites round the diseased area. This is more likely to happen if secondary pyogenic infection has taken place.

Changes in the Joint as a Whole.—These will depend upon :

- (1) The structures attacked first ;
- (2) The severity of the process ;
- (3) The efficiency of treatment ;
- (4) The anatomical structure of the joint ;
- (5) The occurrence of pyogenic infection.

There are four chief conditions found in the active stage of tuberculous joint disease :—

1. DISTENSION OF THE CAPSULE by pulpy synovial membrane and fluid, the ligaments and cartilages being intact.
2. DISLOCATION from destruction of ligaments, or more rarely of the articular surfaces of the bones, aided by neglect of treatment.
3. DESTRUCTION OF THE BONE ENDS.—The cartilages have disappeared, the diseased bones may be carious or necrotic, forming sequestra in the joint, or they may give rise to TUBERCULOUS ABSCESSSES which track outside the joint limits.
4. PYOGENIC INFECTION through opened or burst abscesses.

Ultimate Effect upon the Joint may be one of the following :—

1. RECOVERY.—This is possible only when the original disease has been limited to the bone, or when a synovial affection has been arrested or excised in a very early stage.
2. FIXATION BY ADHESIONS.—This results from the destruction of synovial membrane and cartilage, and their being replaced by granulations which have formed fibrous adhesions.
3. FIBROUS ANKYLOSIS.—This results from a more or less complete destruction of the articular cartilages, followed by a union of opposed granulating surfaces of diseased bone.
Bony ankylosis only occurs if secondary infection takes place (see Fig. 92, p. 291).
4. DISLOCATION.—The diseased tissues recover, but the dislocation remains, and usually the parts become fixed in a mass of fibrous tissue.

Symptoms.—The clinical history can conveniently be divided into three stages, preceded by a latent period ; but of course all these stages cannot be recognized in every case.

LATENT PERIOD.—A history is given of some slight injury, since which there has been apparently complete or partial recovery, with a disinclination to use the joint.

EARLY, 'FIRST', STAGE, OR STAGE OF INVASION of the disease. Here the disease is limited to either the bone or synovial membrane in which it started, and has not spread to the other structures.

- a. **IN SYNOVIAL DISEASE.**—A distension of the joint cavity and formation of a 'white swelling'. The joint is held in a position which allows of the greatest distention of the capsule, e.g., flexion. The muscles in the neighbourhood are wasted. All movement is painful, passive as well as active. Very rarely a fluctuating hydrops articuli may exist.
- b. **IN BONE DISEASE.**—The bone may be swollen ; it is tender on pressure. Pushing or jarring the joint surfaces together is painful. There is no fixation in any special position.

Tuberculous Disease of Joints—Symptoms, *continued*.

and passive movements are painless. Active movements or placing any weight on the limb are painful, because all active movements 'crowd together' the joint surfaces. A skiagram will show a light area in the bone end.

SECOND STAGE, OR STAGE OF FIXATION.—Here the ligaments and cartilages have been infected from the primary focus, and therefore all the joint tissues are affected. All voluntary movement is abolished by pain. The muscles hold the joint by a tonic contraction, in which the most powerful groups gradually overcome the others, thus producing a fixed deformity. Starting pains occur at night, especially when the cartilage is eroded, by the relaxation of this tonic contraction, with consequent jarring of the joint surfaces.

THIRD STAGE, OR STAGE OF DESTRUCTION.—The ligaments have given way, the cartilages are lost, and the bones are carious or necrosed, whilst fixation, wasting, deformity, and pain continue. Further destruction of the joint is manifested by: (1) Actual shortening of the bones; (2) Abscess formation; (3) Dislocation.

If the abscesses open upon the surface and become septic, hectic or lardaceous disease may ensue.

CONSTITUTIONAL SYMPTOMS.—These may be entirely absent. Loss of appetite, general malaise, with loss of flesh, are often seen in acute or extensive cases. A hectic temperature is rarely seen unless a pyogenic infection has been added. But it sometimes occurs in children, and then indicates extensive bone disease.

Complications and Sequelæ.—Phthisis—Tuberculous peritonitis—Meningitis—General miliary tuberculosis (all rare except the first)—Septicæmia or lardaceous disease when an abscess has become infected with pyogenic organisms.

Prognosis.—This is on the whole good. Bad: (1) When treatment cannot be efficiently carried out; (2) In children under three and patients over fifty; (3) In the presence of any visceral complication; (4) When septic complications have occurred.

Treatment.

1. **CONSTITUTIONAL** (*see* TUBERCULOSIS, p. 64).
2. **REST.**—The diseased joint must be protected from movement and from pressure, which aggravates the disease and its consequences. Bed for a short time and splints for a long time. Complete immobilization must be maintained for some time after all pain and tenderness have disappeared. Three to eighteen months is usual.
3. **CORRECTION OF DEFORMITY.**—This is to be carried out as early in the disease as possible. It must be done gradually, e.g., by weight extension. It aims at placing the joint in the most useful position if ankylosis results (*see* p. 273).

4. **WEIGHT (OR ELASTIC) EXTENSION.**—This tends to correct early deformities; to counteract the tonic contraction of the muscles which press the joint surfaces together; to prevent dislocation in the later stages. It is specially useful in diseases of the spine, hip, and knee.
5. **LOCAL TREATMENT.**—To be carried out in conjunction with the above:—
 - a. **COUNTER-IRRITATION** by blisters or cauterly is especially useful for the relief of pain.
 - b. **PASSIVE HYPERÆMIA.** Produced by an elastic band above the joint, applied for one hour daily.
 - c. **INJECTIONS OF IODOFORM:** 1 oz. of a mixture of iodoform 10 parts, water 20, glycerin ad 100.
 - d. **ASPIRATING ABSCESSSES** under careful aseptic precautions. In most cases, however, the presence of an abscess is an indication for radical operative treatment.
6. **TUBERCULIN TREATMENT** under the control of opsonic indices (*see* p. 64).
7. **EXCISION.**—
 - a. **PARTIAL EXCISION** or arthrectomy is an operation of very doubtful utility. If it succeeds in curing, then the disease would probably have been curable without any operation. It usually results in recurrence or ankylosis, with subsequent deformity, requiring a complete excision. It consists in removing diseased synovial membrane with a minimum of ligaments and cartilages, so as to preserve a movable joint.
It is indicated only in young children (under ten) where there is no bone disease, and where careful non-operative treatment is impracticable.
 - b. **COMPLETE EXCISION**, i.e., removal of the bony ends, all cartilages, and most of the ligaments, as well as the synovial membrane.
It is indicated: (i) In cases in which general treatment is impossible or has failed. (ii) When there is definite evidence of bone disease which has involved the joint. (iii) When abscesses have formed, especially when these arise from bone disease. (iv) To cure ankylosis in joints, e.g., the shoulder or elbow. (v) To correct faulty ankylosis, e.g., in the knee.
8. **AMPUTATION.**—This is rarely called for.
INDICATIONS.—In conditions of very bad general health. In elderly patients, especially when the ankle-joint is diseased. When incurable sepsis, with possibly lardaceous disease, has supervened. When excision has failed. When so much bone is diseased that excision would leave a useless limb. When two joints are affected in the same limb.

SYPHILIS OF JOINTS.

Joints are very rarely affected by syphilis, though there are many ways in which syphilis in its various stages may affect them.

Classification.—

SECONDARY STAGE.—Arthralgia. Synovitis—intermittent and painful, or chronic and painless.

TERTIARY STAGE.—Gummatous synovitis. Chondro-arthritis. Virchow's ulcerating joints. Tabetic—Charcot's sclerosing joints.

INHERITED DISEASE.—Suppurative arthritis—in early infancy. Hydrarthrosis. Symmetrical serous synovitis (Clutton's). Gummatous synovitis. Chondro-arthritis (Von Gies' joints). Charcot's joint (juvenile tabes).

1. CHRONIC SYNOVITIS.—Usually symmetrical, occurs in the late secondary stage; most often in the knee-joints. These become distended by effusion, with little or no pain.
2. CHRONIC (GUMMATOUS) ARTHRITIS.—Gummata may be:—
 - a. EXTRA-ARTICULAR.—A chronic swelling outside a joint, which softens and bursts externally.
 - b. INTRA-ARTICULAR.—The synovial membrane is the seat of a local or diffuse gummatous change. A condition is produced very like tuberculous joints. It differs from the latter by being almost painless, and by producing very little destruction of the ligaments and cartilages.
3. OSTEOCHONDRO-ARTHRITIS.—May occur in the late acquired or in the congenital disease. It resembles osteo-arthritis. The cartilages become fibrillated and eroded. The synovial membrane is thick and pulpy; the bony ends are thickened by periostitis. It differs from osteo-arthritis by causing little pain, and occurring usually in much younger subjects. The cartilages are 'punched-out' rather than worn away, and there is no lipping at their edges.

Treatment.—Mercury and iodides by mouth. Firm pressure over mercury ointment applied to the joint.

Excision is seldom required: only in those cases where actual bony destruction has occurred.

OSTEO-ARTHRITIS.

Definition.—This is a chronic joint lesion which is often degenerative rather than inflammatory in its nature. It represents a collection of widely differing diseases which have this one point in common, that they produce fibrillation and destruction of the cartilage at one part of the joint, with the heaping up of new cartilage at another.

Etiology.—The chief groups of causative conditions are:—

DEPRESSION OF THE VITALITY.—Old age. Constant cold and damp.

TOXIC INFLUENCES.—Some pre-existing infectious disease, e.g., rheumatism, scarlet fever, tonsillitis, or influenza. Auto-intoxication by some morbid digestive products in, e.g., catarrh or ulceration of the intestines. Infection by a short bacillus (Bannatyne) is demonstrable in many cases.

NERVOUS CAUSES.—Any lesion of the nerves supplying the joint, especially an irritative neuritis. A lesion of the cord affecting the posterior or central columns, e.g., tabes or syringomyelia, or spina bifida. Possibly indefinite conditions of general nervous debility predispose to or produce it occasionally.

TRAUMATISM often acts as the exciting cause when the above-mentioned predisposing causes may have been present. A single severe injury may rupture the cartilage and produce a mono-articular osteo-arthritis at once. Long-continued overstrain may bring about the condition slowly (e.g., in certain joints in labouring men).

Pathological Anatomy.—

THE CARTILAGES show the first change. The cells proliferate, the matrix becomes fibrillated. The smooth surface is replaced by a velvety or ragged surface. The articular cartilage becomes worn away along the areas of greatest friction. The edges become heaped up like candle gutterings round the margins of the joint.

THE BONES.—Where the articular cartilage has been removed by attrition, the bone becomes hard and polished. Immediately below this the bone is more open in texture and more fatty than normal, i.e., it is undergoing atrophy. A more or less rapid and extensive absorption of the bone end takes place, the actual joint surface remaining sclerosed. The margins of the articular surfaces form projecting osteophytes by the ossification of the cartilaginous nodules. Locking of the joint may result from the exuberance of these osteophytes.

THE SYNOVIAL MEMBRANE may be either atrophied or hypertrophied.

a. **ATROPHY.**—More common in old people. Results in an absence of synovial fluid.

b. **HYPERTROPHY.**—Is the commoner condition. A pulpy cedematous condition is followed by the formation of massive fibrous fringes; these may give rise to pedunculated or loose fibrous or cartilaginous bodies, or the fringes may become filled with fat, forming a 'lipoma arborescens'. The synovial fluid is increased in amount.

ALL THE JOINT TISSUES are thus affected with atrophy and hypertrophy going on side by side; ultimate result will depend on length of disease and predominance of one or other process.

Osteo-arthritis, *continued*.

Clinical Groups of Arthritis Deformans.—

1. CHRONIC MONARTICULAR FORMS.—Often traumatic in origin, frequent in elderly patients. Atrophy of the joint tissues is more evident than hypertrophy. The large joints are specially affected—the shoulder, hip, or knee.
2. CHRONIC POLYARTICULAR FORMS.—Most common in middle-aged women. It results probably from a chronic toxæmia or nerve disease. The hands and feet are affected first, the large joints and spine later. Atrophy and hypertrophy are evenly balanced.
3. ACUTE POLYARTICULAR FORMS.—Most common in young patients. Probably due to bacterial or toxic absorption. The small joints are chiefly affected. It is often preceded by a definite pyrexia. Hypertrophic thickening of the synovial tissues is most prominent.
4. ACUTE FORMS IN CHILDREN (*Still's Disease*).—The lymph-glands and spleen are enlarged. Some pyrexia accompanies the disease. The cartilage and bones suffer less than the synovial membrane.
5. SPONDYLITIS DEFORMANS.—See p. 317.

Symptoms.—

THE ONSET is insidious; usually marked by pain, which recurs in spasms.

THE ORDER of joint affection varies, but usually the wrist and finger joints, the ankles and tarsal joints, suffer first; the hip, knee, and shoulder next; and the spinal joints last. This especially applies to the more acute forms. In the more chronic atrophic forms, one or both shoulders, knees, hips, or the spinal joints, may alone be affected, the incidence being determined by the patient's occupation.

THE CHANGES IN A SINGLE JOINT.—

SWELLING of the synovial tissues, with increased fluid, usually without heat.

THE BONY ENDS are diffusely enlarged.

THE ARTICULAR EDGES become everted and lipped.

GRATING occurs in the joint, and is of two kinds: (1) 'Snowball-crunching', from the presence of fibrous fringes; (2) Harsh grating, from the rubbing together of bared bony surfaces.

THE SHAPE of the joint is that of a spindle.

THE JOINT MOVEMENTS are limited by pain, muscular spasm, and lastly by the locking of osteophytes. The joint stiffness is worse after rest and better after exercise. The joint is held in a position of semiflexion.

Pathological dislocations are very rare.

The disease is generally symmetrically bilateral.

CHANGES IN THE LIMB OUTSIDE THE JOINT.—The skin is glossy over the joints. The muscles undergo marked atrophy. Muscular cramp and spasms are frequent. Bursal swellings, or synovial swellings (Baker's cysts), affected in the same way as the joint, may arise in its neighbourhood.

CHARACTERISTIC HAND CHANGES.—In the common poly-articular types: The first phalangeal joint becomes spindle-shaped. The wrist is puffy. The fingers undergo ulnar deviation. Heberden's nodes grow as osteophytes from the bases of the phalanges.

FEET CHANGES.—In the more acute forms the ligaments give way, and a condition of valgus and flat-foot results.

GENERAL SYMPTOMS.—The pulse-rate is increased. The limbs are cold and blue from bad circulation and vasomotor changes. Constant sweating without pyrexia. Patchy pigmentation.

Diagnosis.—

IN ARTHRITIS, whether acute or tuberculous, if grating occurs in the joint, it is intensely painful. The history is short, and the limb absolutely immobilized. Only in the rare cases of tuberculous hydroys articulari is there any difficulty.

IN GOUT, well-to-do males are affected. It begins in the great toe. Very sudden onset. Tophi, etc.

IN TRAUMATISM, the history is of importance, but often traumatism may be preceded or followed by osteo-arthritis. Crepitus of fractures, adhesions, and tenosynovitis all give a sensation like grating. Immobility at the time and rapid recovery characterize most traumatic lesions.

IN NEW GROWTHS of the bone ends, one bone only is affected. The joint is free at first.

IN CHARCOT'S JOINTS.—Conspicuous absence of pain. Generally an exaggerated bony outgrowth and marked nerve symptoms.

IN CHRONIC SYNOVITIS.—'Snow-crunching' crepitation may occur, but there is much more effusion and no enlargement or lipping of the bones.

IN CHRONIC RHEUMATISM, there is no evidence of thickened synovial membrane, or of enlarged or lipped bony ends.

Prognosis.—Is almost hopeless. The disease may be arrested, but hardly ever cured. It has little or no tendency to shorten life.

Treatment.—

GENERAL.—Avoidance of cold and damp. Dry, bracing climate. Generous diet.

DRUGS.—Guaiacol carbonate (10 gr. t.d.s.), saline aperients, all of which act probably by removing intestinal toxins.

Iodides and salicylates for pain. Arsenic and iron for anæmia.

Osteo-arthritis—Treatment, *continued*.**LOCAL —**

IN EARLY (ACUTE) STAGES.—Firm pressure over warm wool dressing. Stimulating ointment, e.g., Scott's dressing. Massage and passive movements, but rest from active movements.

IN ADVANCED (CHRONIC) STAGES.—Active movements are permitted. Electric baths, thermal baths, etc.

SURGICAL.—Very rarely required. Excision or osteotomy for a locked or crippled joint, e.g., elbow, hip, knee, or jaw. Most suitable for monarticular forms. In some of the dry painful varieties, injection of vaseline.

CHARCOT'S DISEASE.

(*Neuropathic Arthritis.*)

Definition.—An advanced condition of osteo-arthritis resulting from a definite nerve lesion, usually in the spinal cord.

Causes.—Tabes dorsalis (in the great majority of cases)—Syringomyelia—Spina bifida—Hemiplegia, paraplegia, or neuritis. Some actual injury, or the ordinary mechanical strain on the joint, may act as the proximate cause.

Anatomy.—All changes of osteo-arthritis occur in an exaggerated form.

a. THE ATROPHIC FORM shows marked loss of cartilage and bone, and no osteophytes.

b. THE HYPERTROPHIC FORM shows exuberant overgrowth of cartilage and bone at the margin of the joint. Great increase of synovial fluid, and ultimate disorganization of the joint, are marked features.

There is also a great tendency to the formation of osteophytes, which arise in and around the joint by an ossification of periosteum, synovial fringes, and muscular insertions.

Symptoms.—

NERVE SYMPTOMS.—Lightning pains, loss of knee-jerks, pupil changes, some anæsthesia or paræsthesia.

JOINTS AFFECTED.—The knee, hip, shoulder, and ankle are affected in the order of frequency given. Very rarely affects more than one joint.

JOINT SIGNS.—

Very rapid and painless onset usually occurs.

A great synovial distension is the first feature.

All the signs of osteo-arthritis, viz., enlargement of the bone ends, lipping of articular margins, coarse grating, quickly follow.

Marked absorption of bone, with consequent shortening or deformity.

Massive heaping up of new bone as an outgrowth round the articular margins, in the hypertrophic varieties.

Disorganization or dislocation of the joint from a yielding of the ligaments and destruction of the joint surfaces.

Absence of all pain or tenderness is a conspicuous and characteristic feature.

Treatment.—Protection from injury. Aspiration of excessive effusion. Some kind of mechanical support to prevent disorganization of the joint.

HÆMOPHILIA.

Hæmorrhage into the joints causes two varieties of lesion :—

1. IN THE EARLY STAGES : Chronic synovitis.
2. IN THE LATE STAGES as the result of repeated hæmorrhages : Osteo-arthritis.

Incidence of the Affection.—The joints are affected in the same order of frequency as in the case of ordinary traumatism. The knees much more frequently, then the ankles, wrists, elbows, shoulders, and hips. A blow or strain which in a normal person produces a sprain, in a hæmophilic causes a hæmarthrus. Subsequently recurrent synovitis may occur without hæmarthrus.

Pathology.—The synovial cavity is distended with blood. The blood remains unabsorbed for a very long time. Some deposit of fibrin takes place on all the articular surfaces. The chronic irritation thus set up produces : in the cartilages—fibrillation, absorption, and nodular thickening at margins ; in the synovial membrane—thickening, with the formation of fibrous fringes ; in the joint cavity—a tendency to chronic and recurrent synovitis ; in the ligaments—relaxation.

Symptoms.—Acute synovial distension, with heat and pain, are the evidences of the first onset of hæmarthrus. This differs from an ordinary synovitis only in its degree in proportion to the extent of injury, and its slowness to subside.

Chronic and recurrent synovitis, especially in the knee-joints, usually follows repeated attacks of hæmarthrus.

The usual signs of osteo-arthritis of the chronic variety finally supervene. Well-marked grating is felt, and the edges of the articular surfaces are lipped.

Treatment.—Of the hæmarthrus—complete and prolonged rest, with firm pressure and cold applications. Of the recurrent synovitis—an elastic bandage constantly applied to the joint. Avoid any surgical interference, e.g., tapping.

LOOSE BODIES IN JOINTS.

Varieties.—

FIBRINOUS, or 'melon-seed' bodies, formed in conditions of chronic synovitis, sometimes tuberculous.

HÆMORRHAGIC.—By the organization of blood-clot.

Loose Bodies in Joints—Varieties, continued.

CARTILAGINOUS.—By a chipping off of parts of the articular cartilages or of ecchondroses found in osteo-arthritis. They form mulberry-like masses, from the size of a pea to that of a walnut.

BONE.—Usually invested with cartilage; caused by a quiet necrosis, or separated by traumatism.

SYNOVIAL.—The hypertrophied fringes of chronic synovitis may become detached and form fibrous or cartilaginous loose bodies.

Number.—Usually single, may be multiple, and rarely number several hundreds.

Distribution.—Common in the knee, occasional in the elbow, and very rare in any other joint.

Symptoms.—Sudden attack of acute pain, with momentary locking. Often followed by some synovitis. The loose body can often be detected, generally on the inner side of the patella. Chronic synovitis with relaxation of the ligaments supervenes if it is allowed to remain.

Treatment.—Removal through an open incision, which is much easier if the body can first be transfixed.

Diagnosis.—From displaced semilunar cartilage and nipped synovial fringes (*see* p. 266).

ANKYLOSIS OF JOINTS.

False Ankylosis.—The fixation or stiffness of a joint produced by extra-articular lesions. These are:—

1. **CONTRACTION OF THE SKIN** and soft parts, e.g., after burns.
2. **CONTRACTION OF TENDONS** in congenital, paralytic, or traumatic conditions, or after long-continued displacement.
3. **THE MATTING TOGETHER** of the soft parts by an injury or disease.
4. **THE OSSIFICATION OF MUSCLES**—myositis ossificans.
5. **OUTGROWTHS** of the bone, e.g., osteomata, chondromata, or sarcomata.

True Ankylosis.—The fixation or stiffness of a joint produced by intra-articular lesions.

1. **FIBROUS ANKYLOSIS.**—Formed by fibrous adhesions. The fixation is only partial, but attempts at movement produce pain. The causes are:—
 - a. **SYNOVITIS** which has resulted in synovial adhesions, especially tubercle, gonorrhœa, rheumatism.
 - b. **TRAUMATISM.**—This generally produces an extra- as well as an intra-articular ankylosis.
 - c. **ARTHRITIS.**—The cartilages have been to some extent replaced by granulation tissue, which has organized into fibrous adhesions. Especially met with in tuberculous conditions.

- d. NERVE LESIONS, e.g., syringomyelia, or the division of, or neuritis of, a peripheral nerve.
 - e. LONG-CONTINUED ABNORMAL PRESSURE of contiguous bones, e.g., in scoliosis or talipes.
2. BONY ANKYLOSIS.—Formed by the complete destruction of the articular cartilages and the union of adjacent bony surfaces.
 - a. ACUTE SUPPURATIVE ARTHRITIS, either septic or gonorrhoeal.
 - b. CHRONIC TUBERCULOUS ARTHRITIS, especially if secondarily infected.

Diagnosis of the nature of ankylosis.—

IN FALSE OR EXTRA-ARTICULAR ANKYLOSIS there are signs of extra-articular injury or disease, e.g., swelling in the muscles, tendons, or bones. Movement is generally free and painless, but very limited in extent.

IN FIBROUS ANKYLOSIS.—A history of some traumatic, inflammatory, or infective disease. Some movement is possible, but is very painful and accompanied by creaking. There are often swelling and thickening of the synovial tissues.

IN BONY ANKYLOSIS there is absolute rigidity of the joint, and attempts at movement cause no pain.

Treatment.—

MASSAGE, PASSIVE AND ACTIVE MOVEMENTS, WITH HOT-AIR BATHS.—All evidence of active disease, e.g., increasing swelling, heat, redness, or tenderness, must be absent. Should always be tried in the early stages, after the subsidence of active exudation or disease.

FORCIBLE MOVEMENT UNDER AN ANÆSTHETIC, followed by massage and passive movements, etc. In the same class of case as the above, after other measures have failed. When passive movements are very painful. It is of the utmost importance that all active inflammatory disease should be at an end. It is dangerous in all recent tuberculous cases.

GRADUAL CORRECTION OF THE DEFORMITY by, e.g., weight extension. Specially useful in tuberculous disease of hip and knee.

OPERATION OF ARTHROPLASTY.—If all active disease is at an end, the joint may be mobilized by separating the adherent articular surfaces, removing some bone from each, and then sewing a piece of fatty fascia between these surfaces. This will answer best in the hip, where the socket is deep and movements are possible at an early stage.

EXCISION OF THE JOINT TO PRODUCE MOBILITY.—Most often used in ankylosis of the elbow and shoulder. The bone is freely removed, and passive movements are begun a week later.

EXCISION OR OSTEOTOMY, WITH FIXATION.—Used most often in the hip- and knee-joints. For conditions of bony ankylosis in a bad position, or fibrous ankylosis which is painful or weak,

DISEASES OF SPECIAL JOINTS.

SHOULDER-JOINT.

Incidence of Disease.—Inflammatory diseases and tuberculosis rare. Osteo-arthritis very common. Ankylosis (usually extra-articular) very common after traumatism, brachial neuritis, and osteo-arthritis. This is due partly to the facility with which the movements of the scapula replace those of the shoulder, and so prevent active and passive movements.

Synovitis produces a fullness of the deltoid and under the axilla; best marked along the line of the bicipital groove.

Must be distinguished from subdeltoid bursitis, which does not project into the axilla, and which causes little limitation of movements.

Tuberculosis usually begins in the head of the humerus, and may lead to purely extra-articular disease. May take the form of a chronic caries sicca. Abscesses point along the biceps tendon or under the posterior margin of the deltoid.

TREATMENT is expectant in most cases.

OPERATION is indicated when abscesses have formed, or where the skiagram shows extra-articular disease. If excision is done in children (very rare), as little of the epiphysis should be removed as possible.

Ankylosis is very common. When other measures have failed, free excision gives good results.

When ankylosis is inevitable, the arm should be raised almost level with the shoulder, the elbow on a line with the front of the chest. It should be kept in this position by an abduction splint or plaster case. When ankylosed in this position, the arm can be moved well by the scapular muscles.

ELBOW-JOINT.

Synovitis.—Produces a fluctuating swelling behind on either side of the triceps tendon, together with an obscuration of the head of the radius. The joint is held in a flexed and pronated position.

Tuberculosis.—Very common. The joint cavity is always involved because of the smallness of the epiphyses. Early swelling and position as in synovitis. All three bone-ends become diseased.

TREATMENT is usually conservative, especially in children.

Opening and scraping carious foci, with the removal of the synovial membrane, is done in adults and in children in whom abscesses have formed.

A formal excision is reserved for cases where painful or useless ankylosis has occurred.

Ankylosis is common after complicated fractures and after suppurative or tuberculous disease.

If the position is one of flexion, it is a matter for the patient's opinion whether anything should be done; if the position is straight, operation is necessary.

Excision, with free bone removal, gives good results.

WRIST-JOINT.

Incidence of Disease.—Gonorrhœa, osteo-arthritis, and tubercle are common, but all other diseases are rare.

Synovial Disease and distension produce a swelling, chiefly at the back of the wrist, but an extension to the neighbouring tendon-sheaths soon obscures it. The joint is held flexed.

Tuberculous Disease is very chronic and difficult to cure owing to the number of bones and joints involved. Pulpy swelling is well marked behind and at the sides of the joint, and extends downwards over the metacarpals. Pain is constant and severe in the later stages.

TREATMENT is conservative and palliative to the utmost degree. Only actual abscesses justify operation. Limited erosions should repeatedly be tried before an extensive excision. In the worst cases amputation is required.

ANKYLOSIS OF THE WRIST should always be ensured in a position of dorsiflexion.

SACRO-ILIAC JOINT.

Incidence of Disease.—Pyæmic and tuberculous affections are practically the only diseases which affect this joint, and the former presents no special features.

Tuberculous Disease usually affects young adults, and is very rare in children.

SIGNS.—

PUFFY SWELLING over the joint behind.

APPARENT LENGTHENING OF THE LEG.—The anterior superior iliac spine is lowered on the affected side.

ABSCCESS forms, and points over joint behind, in the gluteal region, through the sacro-sciatic foramen, behind the trochanter, in the pelvis, into the rectum, vagina, or perineum.

PRESSURE over the joint, pressing the two ilia together, or forcing them apart, is very painful.

SYMPTOMS.—A general sense of weakness on standing, walking, or straining. A sensation of the pelvis breaking in two. Pain is often referred down the sciatic nerve. The signs and symptoms may be quite latent if only the peripheral parts of the joint are affected.

TREATMENT.—Absolute rest until all active disease is ended.

Opening over the joint posteriorly when abscesses have formed, together with evacuation of the abscesses themselves. Free removal of the diseased bone, removing the part of the ilium posterior to the joint if necessary. Closure without drainage.

A jacket extending from the pelvic brim to the axilla for twelve months subsequent to recovery from the operation.

HIP-JOINT.

Simple Synovitis is rare. It gives the same signs as the early stage of tuberculous disease, and under rest with extension quickly passes off. Any tendency to chronicity or recurrence should be regarded as suspicious of tubercle.

Acute Septic Arthritis.—Usually pyæmic, or may follow typhoid fever or one of the exanthems.

Great distension of the joint cavity, with dislocation backwards, is the common tendency.

TREATMENT by weight extension and early evacuation of the abscess.

Subacute or Chronic Infective Arthritis—This results from gonorrhœa or some other infection. It ends usually in ankylosis.

TREATMENT.—Weight extension to produce a straight leg (*see* ANKYLOSIS).

Tuberculous Disease of the Hip.—

AGE.—Five to fifteen is the commonest age to begin.

PATHOLOGY.—Disease may commence :—

1. IN BONE, the commonest site.—(a) Under the cartilage of the head; (b) In the head near the epiphysial cartilage; (c) In the neck near the epiphysial cartilage; (d) In the acetabulum; (e) At the junction of either trochanter (rare, and not strictly hip-joint disease).

2. IN SYNOVIAL MEMBRANE.

THE DISEASE USUALLY SPREADS, wherever it begins, to the: Head of the femur—Acetabulum—Synovial membrane.

IT SPREADS OCCASIONALLY: Through the acetabulum to the pelvis. From the neck to the shaft and great trochanter, without involving the joint. From synovial membrane to psoas bursa, and thence into the pelvis.

LIGAMENTS are invaded by tuberculous granulations from the synovial membrane. The ligamentum teres disappears early. The posterior part of the capsule is perforated. The ilio-femoral, or anterior part of the capsule, usually remains, or is the last ligament to give way.

SYNOVIAL MEMBRANE.—Is infiltrated by tubercles. Thickened to form a pulpy swelling.

HEAD OF FEMUR becomes carious and stripped of cartilage (*Fig. 91*), or necroses and forms a sequestrum owing to the obliteration of its blood-supply by :—

1. Tuberculous focus in the neck.
2. Synovial disease occluding the blood-vessels in the neck.
3. Destruction of vessels in the ligamentum teres.

ACETABULUM becomes carious. May perforate. May be worn away above and posteriorly by pressure. New bone is formed above and behind the carious acetabulum, thus forming the 'travelling acetabulum'.

NECK OF FEMUR.—Carious focus may spread: (1) Into the joint; (2) Into the shaft and trochanter outside the joint. May form a chronic tuberculous abscess.

JOINT BECOMES ANKYLOSED (*Fig. 92*):—

By fibrous ankylosis due to the union of granulating surfaces, with subsequent fibrosis.

By true bony ankylosis due to union of carious bony surfaces, with subsequent ossification, if secondarily infected.

JOINT BECOMES DISLOCATED: By destruction of the acetabulum;

By destruction of the head or neck; By solution of the ligaments; By contraction of the muscles.

SYMPTOMS.—

FIRST STAGE (Stage of synovitis).—Pain in hip, or in knee due to common nerve-supply. Wasting of the thigh muscles. Fullness of inguinal region. Obliteration of the gluteal fold, with flattened nates.

LAMENESS.—At first only a slight—almost unconscious—limp.

POSITION OF THE LEG.—Thigh is flexed to relax vertical limb of Y ligament. Abducted to relax oblique limb of Y ligament (*Fig. 93, B*). Everted to relax ischiofemoral ligament, and owing to the weight of the limb when patient is lying Leg is apparently lengthened.

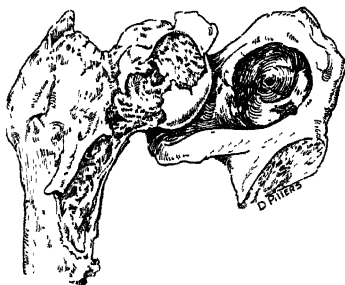


Fig. 91.—Tuberculous hip-joint showing exfoliation of the articular cartilage.

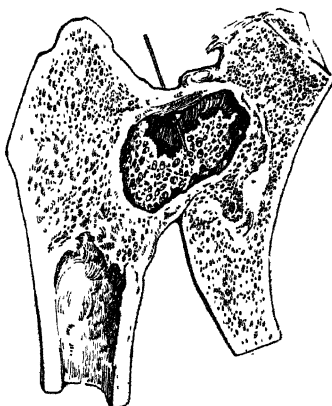


Fig. 92.—Tuberculous hip showing ankylosis. A sequestrum occupies a cavity in the neck of the femur, with a sinus leading from the same.

(*From specimens in the R.C.S. Museum.*)

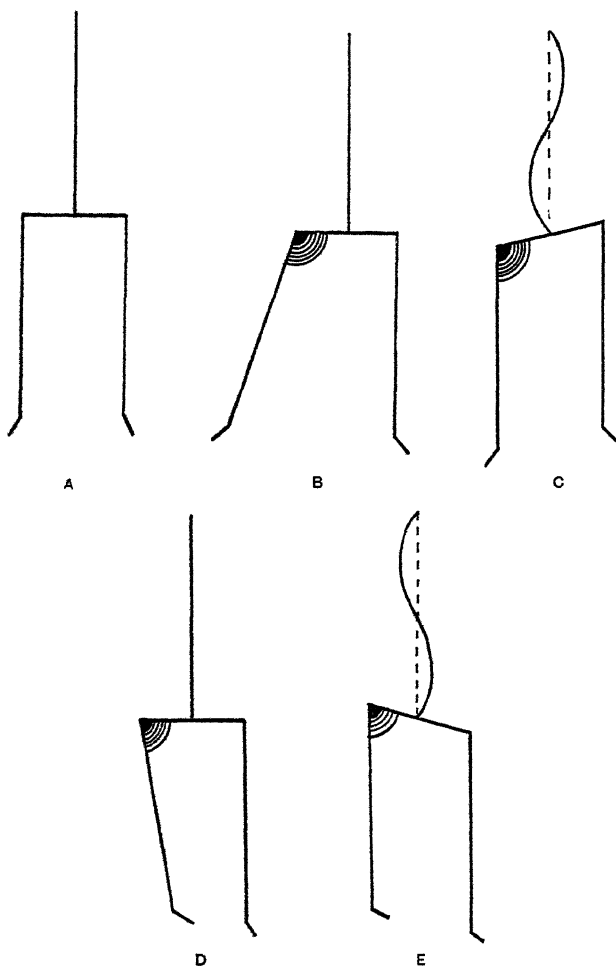


Fig. 93.—Disease or ankylosis of the hip-joint. Diagram showing how the positions of pelvis and spine vary with that of the hip-joint. A, Normal relations. B, Abduction of the hip; position of the leg when the pelvis is level. C, Abduction when the legs are parallel; the pelvis is tilted downwards and the spine curved; the leg is apparently lengthened. D, E, Adduction deformity of the hip; when the legs are parallel the pelvis is tilted upwards and the leg is apparently shortened, while the spine is curved.

POSITION OF THE PELVIS.—Tilted down on diseased side so as to bring abducted thigh parallel to fellow. Hence leg is apparently longer. Lordosis to compensate for flexion of the thigh. (*Fig. 93, C.*)

OBJECTIVE TENDERNESS.—Pain on extension, adduction, inversion, due to strain on capsular ligaments and pressure of joint surfaces together.

Pain on 'crowding joint surfaces together' by pressing the heel or the great trochanter.

Pain on any passive movement, owing to the rubbing of inflamed synovial surfaces.

RIGIDITY.—All movements of the joint limited, especially extension, adduction, and inversion.

SECOND STAGE (Stage of destruction of cartilage and ligaments).—Pain is increased and nocturnal starting occurs. Rigidity is almost absolute.

POSITION OF LEG.—

Flexion.

Adduction. Voluntary movement having ceased, only tonic muscular action is present. The adductors, being much stronger than the abductors, gain this position. (*Fig. 93, D.*)

Inversion. The posterior part of the capsule has given way, and the short external rotators are infiltrated and weakened. (*Fig. 93, D.*)

Apparent shortening.

POSITION OF THE PELVIS.—Lordosis as above. Tilted up on diseased side so as to bring adducted thigh parallel to its fellow; hence scoliosis and apparent shortening. (*Fig. 93, E.*)

THIRD STAGE (Stage of destruction of bone).—Pain as in the second stage. Fever and hectic. Position of the leg as in last in an increased degree, with addition of—

ACTUAL SHORTENING due to: (1) Carious destruction of the head; (2) Carious destruction of the acetabulum; (3) Dislocation; (4) Necrosis of the head; (5) Fracture of the neck.

ABSCESS FORMATION.—Abscess points: At inner side of great trochanter—Gluteal region—Scarpa's triangle—As a psoas abscess—As intrapelvic abscess bursting into rectum, vagina, or bladder, or ischio-rectal fossa—Down the leg towards the knee.

If the abscess bursts and becomes septic, hectic fever and amyloid disease may occur.

DIAGNOSIS.—From:—

PRIMARY PELVIC ABSCESS.

KNEE-JOINT DISEASE.—Knee-joint symptoms.

Tuberculous Disease of the Hip—Diagnosis, *continued*.

CARIES OF THE SPINE, PSOAS ABSCESS.—Angular curvature, pain, and rigidity of spine.

INFLAMED PSOAS BURSA.—Pain only on extension.

SCIATICA.—Nerve tender; flexion hurts more than extension.

SACRO-ILIAC DISEASE.—Compression of pelvis is painful—

Apparent lengthening of leg—Pain over sacro-iliac joint.

(In all the above, true hip-joint movements are unimpaired.)

CONGENITAL DISLOCATION.—Absence of pain—Often bilateral—Reducibility.

OSTEO-ARTHRITIS.—Elderly patient—Long history—Grating—Often free movement.

COXA VARA.—Eversion is combined with adduction—Great prominence of the trochanter—Absence of tenderness on pressure—Passive movements painless.

DIAGNOSIS OF THE STRUCTURE CHIEFLY IMPLICATED IN HIP DISEASE.—

IN SYNOVIAL DISEASE passive movements are almost as painful as active. Movement is much more painful than jarring.

IN DISEASE CHIEFLY AFFECTING THE BONES, active movements are much more painful than passive, because they crowd together joint surfaces by the muscular contraction. Jarring the joint is more painful than passive movements.

TREATMENT.—

CONSERVATIVE TREATMENT is the general rule, because it gives good results, and because operative treatment almost always necessitates a loss of joint function.

1. REST IN BED with weight extension is required until the flexion and some of the abduction or adduction have been cured. Usually a month or less.
2. AMBULATORY FIXATION.—Usually by a plaster spica for about 6 months, followed by a leather or celluloid splint for about two years. Patient walks on crutches, using a high boot or patten on sound leg.
3. EXTRA-ARTICULAR ARTHRODESIS.—The outer aspect of the joint is exposed and a graft cut from the upper end of the shaft and trochanter. This is fixed along the outer side of the joint so as to produce ankylosis.

ARTHRECTOMY without excision is very seldom employed, because conservative measures give such good results in mild cases, and excision is required in most of the advanced cases.

The joint may be opened behind or in front, and the femur temporarily dislocated. All the synovial membrane is dissected away, and carious foci in the femoral neck or acetabulum are scraped.

It may be indicated when prolonged conservative treatment is impossible.

Excision is indicated in the third stage of the disease, i.e. :—

When abscesses have formed which, on opening, are found to communicate with the joint.

When marked shortening indicates joint destruction.

Also when prolonged conservative measures have failed to cure.

THE ANTERIOR INCISION outside the sartorius is the most generally useful, because it divides no important blood-vessels, it affords ready access to the joint, and leaves an anterior scar.

THE POSTERIOR INCISION is most useful when posterior abscesses have formed, or when the head of the bone lies dislocated backwards.

THE REMOVAL OF ALL DISEASED STRUCTURES, especially sequestra in the head and neck of the bone and the acetabulum, is best done by a large flushing gouge.

AFTER-TREATMENT.—The limb should be put up in marked abduction: (1) In order to cause apposition of the stump of the femur and the acetabulum; and (2) To compensate for the shortened limb by the subsequent pelvic tilting downwards on the affected side. An adductor tenotomy may be necessary to bring this about. The limb must be kept abducted for six weeks by a plaster or other splint.

AMPUTATION is very rarely called for. It is indicated when the knee as well as the hip is involved, when other operations have repeatedly failed, when intrapelvic disease is extensive, and when septic sinuses defy other treatment, or when the limb is painful and useless.

Ankylosis of the Hip.—

CAUSES.—Tuberculosis, pyæmia, gonorrhœa, osteo-arthritis, or traumatism.

POSITION.—If no preventive treatment has been employed, flexion, adduction, and inversion will be marked.

TREATMENT.—Nothing is required if the limb is in good position without much shortening.

Gradual correction by weight extension for false or fibrous ankylosis in a bad position.

Fixation in an abducted position (*see AFTER-TREATMENT OF EXCISION OF THE HIP FOR TUBERCULOUS DISEASE, above*) is very valuable in cases with much shortening.

Arthroplasty, in young and vigorous subjects. A U-shaped flap is turned up from the outer side of the trochanteric region, the trochanter sawn off, the joint exposed, and chiselled until the femur is free. Bone is removed from the femoral head and from the acetabulum. The socket is lined by a flap of fascia lata. The limb is moved directly after the skin incision has healed.

Ankylosis of the Hip—Treatment, *continued*.

Osteotomy through the neck of the femur or below the trochanters is required in all cases of bony ankylosis in a faulty position, where the last operation is deemed too severe.

KNEE-JOINT.

Incidence of Disease.—The knee-joint is more commonly affected by injury and disease in all its varieties (except perhaps gout) than any other joint.

Simple Synovitis.—The joint is held in a semi-flexed position.

Swelling appears at the sides of the patella, above and below at first, and then it assumes a horseshoe shape, surrounding the patella, except below in the position of the patellar ligament.

Fluctuation can be obtained from above to below the patella, pressing on the sides of the swelling.

The patella can be made to tap against the femoral condyles.

This is best done when the limb is extended and the quadriceps is relaxed.

Tuberculous Disease (*Fig. 94*) begins most commonly in the bones in children, and in the synovial membrane in adults.

Rarely bone disease may produce an extra-articular abscess without affecting the joint.

IN THE FIRST STAGE of disease of the joint cavity, the signs of synovial distension as above given are present; but the hollows of the knee are filled by a doughy substance instead of fluid.

Later, especially in children, a spindle-shaped swelling is formed by the knee, the muscles of the thigh and calf being much wasted.

IN THE SECOND STAGE, displacement occurs, which in its complete form is fourfold, i.e., displacement of the tibia backwards and outwards, flexion, and external rotation. This is due to the predominant action of the hamstring muscles, and especially the biceps.

THIRD STAGE.—Actual shortening of either femur or tibia, or of both, from absorption, is produced by bone destruction.

Abscesses form, and usually point at the side of the patella, but may track up the thigh or down the leg.

TREATMENT.—The knee-joint probably gives worse results than any other after conservative treatment, i.e., the majority of cases relapse after it, and come to an eventual operation.

CONSERVATIVE TREATMENT.—The limb is, if necessary, straightened by a weight extension, and then fixed in a Thomas's knee splint. Bier's treatment may be well combined with this. Probably six to twelve months will be required, but much shorter periods are usually employed. It is indicated as a first measure in all early cases, especially in children; and in cases when the disease is purely osseous or purely synovial.

ARTHRECTOMY, i.e., a removal of all the synovial membrane, and but little of the cartilages, gouging out carious bone foci, with an attempt to leave a movable joint.

This very seldom succeeds, and leaves either a weak, painful, fibrous ankylosis, or requires a more radical excision. It is specially adapted for synovial disease in young children.

EXCISION is indicated: (1) When conservative measures have failed; (2) When the disease has progressed to the second and third stages; (3) In almost all adult cases; (4) When faulty ankylosis has occurred.

Bony ankylosis in a straight position should be aimed at. The lateral and crucial ligaments are freely divided and all the synovial membrane and cartilages removed, with all the diseased bone.

After excision in children it is essential that a long cast splint, from the gluteal fold to the ankle, should be worn until bone growth has ceased. Otherwise bending will probably occur at the site of excision.

AMPUTATION is very rarely called for. Septic sinuses with necrosis at the back of the joint may demand it.

Ankylosis usually results from septic or tuberculous arthritis.

Flexion with backward and outward displacement of the tibia and eversion of the leg is the common position. Hyperextension is occasionally seen.

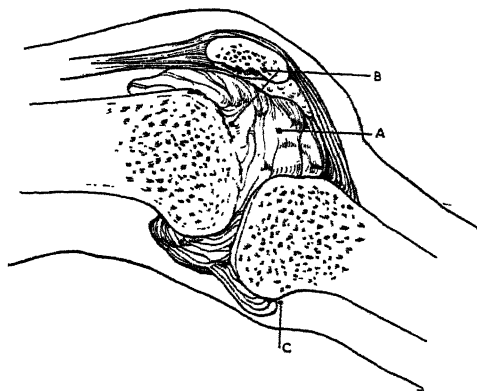


Fig. 94.—Tuberculous disease of the knee-joint, viewed in section. The tibia is dislocated backwards. A, Diseased synovial membrane; B, Articular surfaces eroded; C, Extension of synovial disease downwards and backwards into the leg.

Ankylosis of the Knee-joint—Treatment, *continued*.

TREATMENT.—Weight extension, aided by hamstring tenotomies in slight fibrous cases. Excision and fixation in bad fibrous ankylosis. Cuneiform osteotomy and rectification in bony ankylosis.

ANKLE-JOINT.

Synovial Distension is rare from simple causes. The characters are similar to the early stages of tuberculous disease.

Tuberculous Disease begins in the astragalus, or less commonly in the synovial membrane or tibia or fibula. The swelling appears under the extensor tendons in front of the joint, and at the sides of the tendo Achillis behind. The foot is held in a position of plantar flexion.

The disease is very liable to spread to the other tarsal joints.

TREATMENT.—Conservative measures should be given a prolonged trial.

Scraping out diseased foci through anterior incisions, with **REMOVAL OF THE ASTRAGALUS**, is required in relapsing or suppurating cases.

AMPUTATION is indicated when other measures have failed, and especially in older patients.

Ankylosis.—This is very common as the result of injury or talipes. If in faulty position an astragalectomy will often enable it to be rectified.

TARSAL JOINTS.

Incidence of Disease.—Gonorrhœa, tubercle, osteo-arthritis, and gout are the commonest affections, together with the changes secondary to various forms of talipes.

Tuberculous Disease.—Bones are often primarily affected, especially the os calcis, astragalus, scaphoid, and cuboid.

The joints between the astragalus and scaphoid, the three cuneiforms, and the three inner metatarsals communicate with one another so easily that disease of one generally spreads to the others.

The joints between the os calcis and cuboid, and between the cuboid and the two outer metatarsals, may be affected singly. Swelling occurs over the affected joints, and is diffuse. Tenderness is marked over affected bones.

TREATMENT.—**CONSERVATIVE TREATMENT** should be tried for prolonged periods.

LIMITED OPERATIONS are suitable only in rare cases when one bone or joint is alone affected, e.g., the astragalus or os calcis, or calcaneo-cuboid joint.

AMPUTATION by Syme's method is usually required in cases where other methods have failed, when septic sinuses have arisen, and when the patient cannot afford long conservative treatment.

CHAPTER XXV.

THE DIAGNOSIS OF AFFECTIONS OF THE JOINTS.

The History.—

1. **TRAUMATISM.**—The nature, time, and degree of injury should be ascertained. Thus, in **FRACTURES**, **DISLOCATIONS**, and **SPRAINS**, the injury is great and the disability immediate. A trivial injury, followed by joint affection after a quiescent interval, is characteristic of **TUBERCULOUS DISEASE**. An injury of moderate degree, which is often indirect, followed by a swelling after a short interval, indicates **SYNOVITIS**. A trivial injury, followed by immediate painless swelling, is suggestive of **HÆMOPHILIA**.
2. **A PRE-EXISTING DISEASE.**—One of the exanthemata—e.g., scarlet fever—influenza, or enteric may cause a **SUPPURATIVE ARTHRITIS**. Parturition, or any septic ulcer or wound, may precede **PYÆMIC ARTHRITIS**. Gonorrhœa or gleet occurs before **GONOCOCCAL AFFECTIONS** of the joints. **HÆMOPHILIA**.
3. **THE PROGRESS OF THE DISEASE.**—The history of previous attacks and intermittence in the symptoms is characteristic of **INTERNAL DERANGEMENT**; Sudden onset, with rapid amelioration, of **TRAUMATIC AFFECTIONS**; Slow and steady progress, of **TUBERCULOUS DISEASE**; Great chronicity, with intermittence of the symptoms, of **OSTEO-ARTHRITIS**.

Classification of joint affections for diagnostic purposes.—

1. **TRAUMATIC.**—Arising as the direct result of an injury. Fractures involving joint—Dislocations—Sprains—Separated epiphyses—Traumatic synovitis and arthritis—Hæmarthrus and hæmophilia.
2. **ACUTE INFLAMMATORY.**—Presenting the physical signs of inflammation.
 - a. **LOCALIZED TO A SINGLE JOINT.**—Synovitis and arthritis (simple or septic)—Acute gout—Acute infantile arthritis, pyæmia, and specific fevers exceptionally attack a single joint.
 - b. **INVOLVING MANY JOINTS.**—Pyæmia—Specific fevers—Rheumatism—Gonorrhœa—Acute arthritis of infants—Acute osteo-arthritis.

Classification of Joint Affections, continued.**3. CHRONIC SPECIFIC INFECTIONS.—**

- a. **TUBERCULOUS.**—Pain, with the absence of other signs of inflammation, and chronicity, with steady progress, are the main signs of this. Also the reaction to tuberculin may be useful in obscure cases.
- b. **SYPHILITIC.**—These are rare and seldom diagnosed in the absence of other evidence of syphilis. Chronic or subacute synovitis or arthritis, with marked absence of pain, is suggestive.

4. **DEGENERATIVE, or chronic inflammatory.**—Conspicuous deformity of the articular ends of the bones, generally with marked grating and increased synovial fluid, are the characteristics of this class, which includes: Osteo-arthritis (the various chronic forms)—Charcot's disease—Chronic hæmophilia—Chronic gout—Chronic synovitis.

Physical Examination of the affected joint. Comparison should always be made with the sound side.

1. **SWELLING.**—The shape, position, and character of any swelling determine whether it affects the synovial membrane, the bony ends, or adjacent structures, e.g., bursæ or tendon sheaths.
2. **INFLAMMATORY SIGNS** are redness, heat, tenderness, pain, and œdema. These indicate various forms of synovitis and arthritis. Marked œdema and acute tenderness indicate suppuration. Swelling and tenderness over the bones, with starting pains at night, occur when the cartilages and bones are diseased, i.e., in arthritis, as distinguished from synovitis.
3. **MEASUREMENT OF THE GIRTH.**—At the joint it indicates the degree of swelling. Above and below the joint it shows whether there is any muscular wasting, such as occurs so conspicuously in tuberculous and osteo-arthritic limbs. Care should be taken in these measurements to take corresponding points on the two limbs, i.e., at a definite distance from a bony point.
4. **RELATIVE POSITION OF BONY POINTS.**—Two precautions are necessary: (a) To take points which accurately correspond to one another on the two sides; (b) To have the two limbs in the same position during the measurement.

IF THE BONY POINTS ARE SITUATED ON THE SAME BONE, e.g., the olecranon and the styloid process of the ulna, an altered measurement shows a fracture or disease of the bone.

IF THE BONY POINTS ARE SITUATED ON DIFFERENT BONES, altered measurements may show abnormality of any of the bones or joints intervening between the two points—e.g., the distance from the anterior superior iliac spine to the internal malleolus may be altered by injury or disease of the ilium, acetabulum, hip-joint, neck or shaft of the femur, knee-joint, or tibia.

IF THE BONY POINTS ARE SITUATED ADJACENT TO A JOINT, altered measurements indicate an affection of the joint, or the bony ends concerned in it—e.g., the relation of the iliac spine to the trochanter shows the condition of the hip-joint or head and neck of the femur.

These measurements are of especial value in traumatic conditions, e.g., FRACTURES AND DISLOCATIONS, and in TUBERCULOUS JOINT DISEASE.

5. PASSIVE MOVEMENTS.—Care should be taken to exclude movements of neighbouring joints, e.g., in the shoulder-joint the scapula should be fixed, and in the hip-joint the pelvis.

ABSOLUTE PAINLESS FIXATION indicates bony ankylosis.

PARTIAL FIXATION WITH PAINFUL MOVEMENT indicates synovitis, arthritis, or fibrous ankylosis.

MOVEMENT WHICH IS FREE AND PAINLESS, BUT LIMITED, indicates false or extra-articular ankylosis, and often results from fracture or dislocation.

PAINLESS GRATING indicates chronic osteo-arthritis, Charcot's joint, chronic hæmophilia, or chronic synovitis.

PAINFUL GRATING indicates cartilage destruction and bone disease in arthritis, notably in tuberculous conditions.

THE RANGE OF MOVEMENT NOT ALTERING UNDER ANÆSTHESIA indicates organized ankylosis, as distinguished from the early stages of synovitis and arthritis.

6. ACTIVE MOVEMENTS.—Generally correspond with passive movements.

MARKED LOSS OF ACTIVE AS COMPARED WITH PASSIVE MOVEMENTS suggests a nerve injury producing paralysis.

ACTIVE MOVEMENTS BEING MUCH MORE PAINFUL THAN PASSIVE indicates that the joint surfaces, and especially the bony ends, are involved, because every active movement tends to 'crowd together' the joint surfaces. In general terms this distinguishes arthritis and bone disease from mere synovial disease.

PRESSING THE BONY ENDS TOGETHER is productive of pain in the same class of case.

7. EXCLUSION OF NEIGHBOURING STRUCTURES.—These are particularly: (a) Bursæ; and (b) Tendon sheaths. The locality of the swelling and the limited character of painful movements should enable one to exclude these.

CHAPTER XXVI.

INJURIES AND DISEASES OF THE SPINE.**FRACTURES OF THE SPINE.****Causes.—**

DIRECT VIOLENCE.—Spine breaks at the point struck.

INDIRECT VIOLENCE.—Spine usually breaks at about the junction between the most movable and the most fixed parts, i.e., between the neck and back, or between the thorax and lumbar region.

Varieties.—

INCOMPLETE FRACTURES.—The continuity of the column is not destroyed.

Spinous processes, transverse processes, and laminae may be broken and displaced. They are of importance because late affections of the cord may follow, and also because they may cause pain in the back and inability to work. Such conditions must be sought for in all cases of chronic back sprain.

COMPLETE FRACTURES or fracture-dislocations

COMPRESSION FRACTURES.—One or more bodies and discs are crushed.

Fracture-dislocations.—

ANATOMY.—Most common in the cervical and upper dorsal regions, also in the last dorsal and first lumbar vertebrae. The articular processes are always fractured, except occasionally in the cervical region. The body or intervertebral disc is fractured or torn, The ligaments are extensively lacerated. Fracture, comminution, and impaction of the laminae and spinous processes may occur. The upper fragment is usually displaced forward.

The cord is either crushed between the laminae above and the bodies below, or it is cut across or transfixed by bony fragments, or its structural continuity is severed, whilst the bones regain their normal position by natural recoil or treatment.

SIGNS.—

DEFORMITY OF THE SPINE.—Usually an angular curvature. There may be a mere irregularity in the line of the spinous processes.

SIGNS OF LOCAL TRAUMA.—Bruising, pain, swelling.

CREPITUS is indistinct, and not to be sought for except with the utmost gentleness.

PARAPLEGIA, ANÆSTHESIA, LOSS OF THE REFLEXES (see p. 306).

VASOMOTOR PARALYSIS, with rise of temperature in the parts below the lesion up to 110° F., or even higher.

TROPHIC LESIONS.—

1. Acute bedsores form over the sacrum or buttocks. Less often over the anterior superior spine or heels. They occur about three days after the injury, or at any later date if myelitis arises. Pressure, and fouling with urine or fæces, act as exciting causes. A large deep slough forms rapidly, and finally the bone is exposed.
2. Of the urinary organs. Sloughing may occur in the bladder, urethra, penis, or scrotum. Septic inflammation ascends to the kidney as a pyelitis and pyelonephritis.

AFFECTION OF THE BLADDER MUSCLES.—Either true incontinence, retention with overflow, or involuntary reflex micturition.

PARALYSIS OF THE RECTUM or its sphincters.

METEORISM from the abdominal-wall paralysis.

PRIAPISM.

EMBARRASSMENT OF RESPIRATION by the paralysis of the abdominal muscles and the intercostals.

TREATMENT.—

GENERAL.—To be lifted upon some supporting sheet, and not picked up by the legs and shoulders. Bed should be firm and upon fracture boards. Special care of the lower extremities lest they get burned by hot-water bottles.

REDUCTION under an anæsthetic.—If the lesion is below the cervical region; if the paraplegia is incomplete. Is best performed about twenty-four hours after the accident, when shock has passed off.

LAMINECTOMY.—(1) If the injury to the cord is only partial, indicated by a retention of the deep reflexes and of the sense of heat and pain. (2) Lesions of the cervical spine. (3) Lesions of the cauda equina. (4) When paraplegia arises at an interval after the accident. (5) When the neural arch is driven in.

Immediate operation for the actual cord injury is never necessary, and should be delayed at least three weeks—i.e., until after spinal shock has passed off.

SYMPTOMATIC TREATMENT.—(a) Alone: when total transverse lesion has occurred. (b) In conjunction with or following any of the above: Retention apparatus, e.g., sand-bags. Patient should be moved as a whole and not twisted. Skin kept dry and clean with spirit lotions and antiseptic powders. The sheets kept smooth and clean. The urethra disinfected and kept covered by an antiseptic dressing. The urine drawn off by sterile rubber catheter where vesical paralysis exists.

Compression Fractures.—

ANATOMY.—Usually found at the junction of the dorsal and lumbar spine, from the 11th dorsal to the 2nd lumbar vertebræ. Caused by violent flexion forwards of the body. One or two of the bodies and discs are crushed together, and appear to be wedge-shaped when viewed laterally. (*Figs. 95, 96.*)

KÜMMEL'S DISEASE is a variety of this injury in which the original accident is comparatively slight and in which the symptoms do not appear for some months after the patient has been getting about. Possibly in this disease the original injury is one to the blood-vessels, causing bone atrophy with subsequent yielding of the soft bone under the body weight.

SYMPTOMS AND SIGNS.—Pain and weakness in the back. There is prominence of one vertebral spine which corresponds to the area of maximum tenderness. Often there is exaggeration of the knee-jerks and marked neurasthenia. Lateral X rays show one or two vertebral bodies to be wedge-shaped, and the discs damaged or distorted.

TREATMENT.—This should be carried out at once, before fixation of the deformity has had time to occur and before neurasthenia develops.

1. **HYPEREXTENSION WITH PLASTER.**—The patient is slung face downwards and the spine forcibly hyperextended. Fixed by a plaster jacket in this position. Jacket retained for three months and followed by a brace, worn for a year.
2. **BONE GRAFT.**—For young adults. A tibial graft is attached to the spinous processes, extending well above and below the injured area.
3. **SPINAL BRACE.**—Used for patients unsuited for, or refusing operation, and as the after-treatment of either of the above.



Fig. 95.

Fig. 95.—Compression fracture of 1st lumbar vertebra



Fig. 96.

Fig. 96.—Kummel's disease affecting the 10th and 11th dorsal vertebræ.

DISLOCATIONS OF THE SPINE.

OCCUR only in the cervical region, where the horizontal articular surfaces allow this possibility; most commonly between the 5th and 6th cervical vertebræ.

VARIETIES.—Unilateral and bilateral.

DISPLACEMENT.—The upper part of the spine is displaced forwards, the articular processes locking against the lower.

SYMPTOMS AND SIGNS.—Sudden death in complete dislocations in the upper part. Signs of cord injury in most cases. Neuralgia of the nerves at the seat of injury. Some deformity, either forward displacement or rotation.

TREATMENT.—Reduction under an anæsthetic, or open operation when reduction has failed, with, possibly, removal of part of the lower articular processes.

DISEASES OF THE SPINAL CORD AND NERVES
WHICH MAY FOLLOW INJURIES.

Varieties.—(1) Traumatic neurasthenia (railway spine); (2) Concussion of the cord (molecular disintegration); (3) Spinal meningitis; (4) Hæmorrhage into or around the cord; (5) Myelitis; (6) Laceration of the cord; (7) Paraplegia.

1. **Traumatic Neurasthenia** (railway spine) occurs after a severe accident which has caused both mental and physical shock.

THE SYMPTOMS are usually absent or trivial for the first few days after the accident. Pain in the head and back, especially in the lumbar region. Mental changes: a loss of the power of concentration, undue excitability, etc. Some functional disturbance of micturition. Varying and changing areas of partial anæsthesia or hyperæsthesia.

TREATMENT is constitutional—chiefly rest.

2. **Concussion of the Cord.**—A molecular injury or disintegration without visible lesion.

It produces exactly the same SYMPTOMS as a partial or total laceration at the time, but the symptoms (paraplegia) may rapidly disappear. Priapism is said not to occur in concussion. But more frequently the symptoms are permanent.

3. **Spinal Meningitis** may be simple and plastic, or septic.

Localized pain in the back increased by movement. Neuralgic pain along the course of the spinal nerves. Spastic rigidity, painful cramps. Hyperæsthesia, exaggerated reflexes.

4. **Spinal Hæmorrhage.**—

- a. **INTRAMEDULLARY.**—Hæmorrhage into the central parts of the cord. Most common in the lower cervical region.

Paraplegia of an incomplete type immediately follows the injury. Senses of pain and temperature are often lost without anæsthesia. No signs of irritation of the spinal nerves. Permanent damage caused by spinal degeneration.

Spinal Hæmorrhage, continued.

- b. **EXTRAMEDULLARY.**—Hæmorrhage between the bones and dura, and between the dura and cord.

Paralysis comes on gradually at an interval after the injury. Severe pain with muscular spasms is caused by irritation of the roots of the spinal nerves.

Recovery may be expected, as no permanent cord damage results.

5. **Myelitis** may arise from a septic wound or as a part of the result of any spinal injury.

The usual symptoms of paraplegia are associated with specially marked trophic disturbances, e.g., acute bedsores, or sloughing cystitis; rapid atrophy of muscles supplied by the affected segments.

6. **Laceration of the Cord.**—Paraplegia is the most constant and earliest result. Meningitis or myelitis often complicates the paraplegia. Spinal hæmorrhage may accompany or may cause the paraplegia.

7. **Paraplegia** resulting from spinal injuries.—

RELATION OF THE CORD TO THE VERTEBRAL SPINES:—

Fourth cervical nerve segment (diaphragm) corresponds to 2nd cervical spine.

The cervical enlargement (arm) to 3rd–7th cervical spines.

The lumbar enlargement to 10th–12th dorsal spines.

The lumbar segments (front of the thigh, etc.) to 9th–11th dorsal spines.

The sacral segments (the rest of the leg, etc., rectum and bladder) to 11th dorsal–1st lumbar spines.

Cauda equina to 2nd lumbar–2nd sacral spines.

CAUSES OF TRAUMATIC (SPINAL) PARAPLEGIA.—

1. **IMMEDIATELY** following the injury.—Concussion (without manifest injury). Contusion with intramedullary hæmorrhage. Laceration of the cord by crushing or penetrating wounds.

2. **ARISING AFTER AN INTERVAL.**—Extramedullary hæmorrhage (twenty-four to forty-eight hours after, without pyrexia). Inflammatory exudation of meningitis (three days or more after, with pyrexia). Pressure of callus or cicatrices (two weeks or more after).

SIGNS OF A TOTAL TRANSVERSE LESION.—

1. **IN THE AREA SUPPLIED BY THE NERVES BELOW THE LESION.**—Complete motor paralysis, followed by late rigidity and contraction of the muscles. Complete anæsthesia, with loss of senses of pain or temperature. Complete and permanent loss of the deep reflexes. Temporary loss of the superficial reflexes. Vasomotor paralysis, with trophic lesions. Visceral paralysis (bladder, rectum, intestines) according to the site.

2. IN THE AREA SUPPLIED BY THE NERVES AT THE SITE OF THE LESION.—Paralysis, with rapid and flaccid atrophy of the muscles. Zone of hyperæsthesia from nerve-root irritation.

SIGNS OF A PARTIAL LESION.—The central parts of the cord may escape injury. In this case the deep reflexes are retained or soon regained; the senses of pain and of temperature are retained; the anæsthesia may be only partial.

In cases of recovery from concussion or contusion the functions of the cord are regained in the following order: Deep reflexes—Sense of pain and temperature—Tactile sensation—Motor power.

Special Features of lesions occurring at different levels of the spine.—

1. LOWER LUMBAR AND SACRAL REGIONS.—The cauda equina is crushed.

Paralysis of all leg muscles except the psoas, iliacus, quadriceps extensor femoris, and the adductors.

Paralysis of all the perineal and penile muscles.

Anæsthesia of the perineal and genital regions, also of the foot and the outer side and back of the leg below the knee.

Bladder is paralysed. Retention at first with overflow, but true incontinence later from atrophy and relaxation of the sphincters.

Rectum: The sphincter is paralysed, and incontinence of fæces results.

2. LOWER DORSAL AND UPPER LUMBAR REGIONS.—The lumbar enlargement is injured, with the origins of the lumbar and sacral plexuses, and the centres for the bladder and rectum.

Total paralysis and anæsthesia of the legs and perineum.

Bladder and rectum, from an injury to their centres, have their sphincters relaxed from the first, with true incontinence of urine and fæces.

Marked tendency to sloughing of the skin and bladder.

3. MID-DORSAL REGION.—In addition to the paralysis and anæsthesia in the last, paralysis and anæsthesia of the abdominal wall and some of the lower intercostal spaces.

Meteorism results from the abdominal paralysis.

A painful girdle at the waist occurs from hyperæsthesia.

Bladder shows retention with overflow, but later a reflex involuntary micturition may occur.

Rectum is not much affected, but constipation is marked from the abdominal paralysis.

4. UPPER DORSAL REGION.—In addition to the above, paralysis of the intercostal muscles.

Bronchitis with congestive pneumonia is very frequent.

Priapism may occur.

Special Features of Lesions at Different Levels, *continued*.

5. LOWER CERVICAL REGION.—In addition to the last, paralysis and anaesthesia of the arms. Priapism is almost constant. The pupils are narrowly contracted, forming the so-called 'spinal miosis', from a cutting of the sympathetic fibres to the pupil, which descend in the cord and then leave by the lower cervical and upper dorsal nerves.
- SEVENTH CERVICAL SEGMENT.—Hands half closed. Elbows bent and forearms pronated over chest.
- SIXTH CERVICAL SEGMENT.—Arms rolled out and abducted. Elbows flexed. Hands supinated. Fingers semiflexed.
- FIFTH CERVICAL SEGMENT.—Arms paralysed and by side of trunk.
6. AT OR ABOVE THE THIRD CERVICAL.—Death from asphyxia, due to involvement of the phrenic (fourth cervical) and the intercostal nerves.

TUMOURS OF THE SPINAL CORD.

Position.—Meningeal (66 per cent). Extradural (20 per cent). Intramedullary 1.4 per cent.

Nature.—

1. MENINGEAL.—Meningioma—hard and localized, or soft and spreading.
2. EXTRADURAL.—Sarcoma. Lipoma. Fibroma. Angioma.
3. INTRAMEDULLARY.—Glioma. Granuloma.

Symptoms are very slow and insidious, and therefore most cases are overlooked and mistaken for spastic paralysis or disseminated sclerosis.

PAIN, chiefly marked at the part corresponding to the spinal segment, e.g., in the arms in a lower cervical tumour. Most marked in extradural and meningeal growths.

PARÆSTHESIA as a band or girdle—when the posterior roots are irritated—affords the best localizing evidence.

PARALYSIS WITH WASTING in the parts supplied by the segments affected.

PARALYSIS WITH SPASM in the parts below the lesion. Thus spastic paralysis of the legs with exaggerated reflexes is present in nearly all cases.

ANÆSTHESIA of variable extent and degree.

VISCERAL PARALYSIS of bladder and rectum are late symptoms.

Diagnosis is often very difficult. The association of an area of pain above (corresponding to the lesion) with an area of spastic paralysis below is the most significant feature. The injection of lipiodol through the occipito-atlantal membrane and subsequent X-ray examination will locate a tumour if it is obstructing the dural canal.

Treatment.—Removal.

LAMINECTOMY of several vertebræ. The mistake is usually made of exploring too low.

OPENING THE DURA.—If the growth is intradural it may be removed. If intraspinal, the cord is divided longitudinally over the growth and the wound temporarily closed.

SECOND STAGE.—A week later the wound is opened and the tumour is often found to have extruded itself upon the surface.

CLOSURE OF THE WOUND.—The dura, muscles, and skin are very carefully closed in separate layers.

SPINA BIFIDA.

Definition.—A deficiency of the vertebral neural arches, through which a tumour formed by mal-developed cord or membranes protrudes.

Varieties (*Fig. 97*).—

MYELOCELE.—Central canal of the cord opens upon the skin surface in the sacral region (incompatible with life).

SYRINGOMYELOCELE.—Central canal is dilated, and the nerves pass outside the cyst.

MENINGOMYELOCELE.—Dilatation of the membranes forms a cyst; the cord is attached to its dorsal wall, and the nerves pass through the cyst.

MENINGOCELE.—A cyst formed of spinal membranes posterior to the cord, which is not affected.

SPINA BIFIDA OCCULTA.—No tumour occurs, except perhaps a lipoma, or a dermoid with long hair.

Signs.—

TUMOUR in the median line of the spine. Usually over the lumbo-sacral region, rarely in the cervical or dorsal. The tumour is (except in spina bifida occulta) translucent and fluctuating.

PRESSURE ON THE TUMOUR produces bulging of the anterior fontanelle, and convulsions.

THE EDGES OF THE GAP in the vertebral laminæ can be felt.

THE SKIN COVERING THE TUMOUR is thin, red, often covered with dilated vessels or ulcerated.

Complications.—These are most often found in the syringomyelocle.

Other congenital defects—hydrocephalus, talipes. Trophic ulcers, perforating ulcer. Arthropathies (Charcot's joint). Ankylosis of the small joints of toes. Various forms of paraplegia.

Prognosis.—Usually very bad. It is serious according to the variety in the order named above. The thickness and nutrition of the overlying skin form another great factor in prognosis.

310 INJURIES AND DISEASES OF THE SPINE

Spina Bifida. continued.

Treatment.—

MERE PROTECTION by a pad if the skin is thick and healthy.

PUNCTURE.

PUNCTURE FOLLOWED BY IODINE INJECTIONS (iodine gr. x, potass. iod. gr xxx, glycerin $\frac{5}{8}$ j).

OPERATION, with an attempt to replace the cord and nerves and sew the membrane and skin over them.

The patient is placed in an inverted position to lessen the escape of fluid. The prospect of success is very slight, except in pure meningoceles, which are rare.

REMOVAL OF A LIPOMA OR DERMOID in spina bifida occulta when it is causing paraplegia.

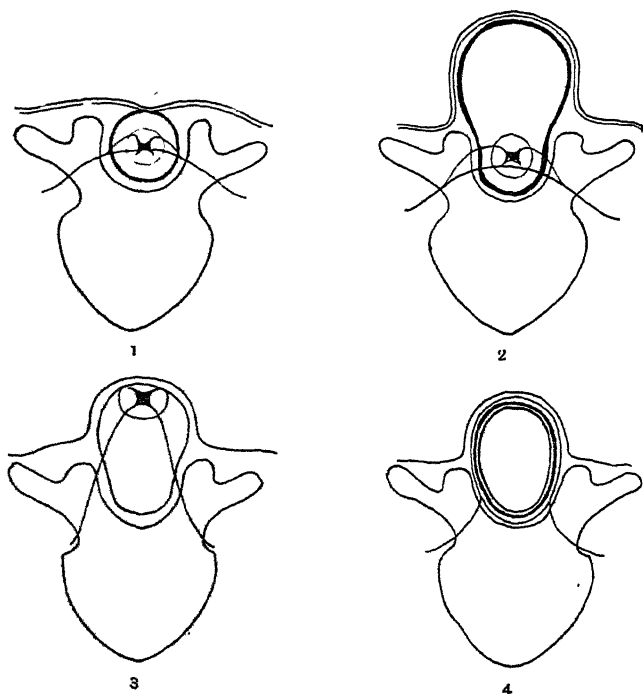


Fig. 97.—Varieties of spina bifida. 1, Spina bifida occulta, with normal cord; 2, Meningocele; 3, Meningomyelocele; 4, Syringomyelocele.

SACRO-COCCYGEAL TUMOURS.

Origin.—From non-closure or overgrowth of the neurenteric canal.

Varieties.—Dermoid cyst (in connection with the posterior rectal wall; between the rectum and coccyx; on the skin surface over the coccyx or sacrum). Composite tumours chiefly are: Myxomatous adenoma (probably this is really a teratoma). Lipoma (probably a degenerate dermoid). Teratoma or partially developed twin. Cystic hygroma. Sarcoma.

Treatment.—Removal by dissection.

If this has to be done in infancy the results are very bad.

TUBERCULOUS DISEASE OF THE SPINE.

(*Pott's Disease.*)

Etiology.—Children most commonly, but it may occur at any age. A strain or blow may act as a predisposing cause.

Anatomy.—Lower dorsal region is the common site. Cervical region rarely affected, except in children. Lumbar region rarely affected, except in adults. There are three different anatomical types:—

1. **PERIOSTEAL.**—The disease begins beneath the periosteum of the bodies, beneath the anterior common ligament. It spreads beneath the ligament from body to body, and so affects a number of vertebræ. It invades the regions of the intervertebral discs.

It is specially common in adults.

It produces no angle, but only a slight kyphotic bend.

2. **CENTRAL.**—The disease begins in the body at the point at which the thin epiphysis joins it. It spreads into the centrum, the adjacent disc, and thence to the next body, producing caries and softening. The weight of the column above compresses and crushes the soft carious bodies, and produces an angular deformity. This form thus attacks a few (usually two) vertebræ only (*Fig. 98*).

It is the common type in children.

3. **LOCALIZED DISEASE** limited to one vertebra.—Usually in the lumbar region. Either under the anterior common ligament, or affecting one of the processes. A definite sequestrum may be formed.

No deformity and very few symptoms unless an abscess result.

After its origin, CASEATION, SUPPURATION, or NECROSIS (rarely) takes place.

THE DISEASE SPREADS by abscess formation (*see p. 313*), or more rarely to the spinal membranes, producing a local thickening, with pressure on, or disease of, the cord.

Pott's Disease—Anatomy, *continued*.

CURE TAKES PLACE by a falling together of healthy bones so as to obliterate the diseased focus.

ANKYLOSIS, with obliteration of the affected joints, is the last stage.

Signs and Symptoms.—**1. PAIN.—**

- a.* LOCAL PAIN at the site of the disease. Often inconspicuous, but it may be a constant dull ache.

Is produced by jarring the spinous processes; by pressure on the head or jerks on the feet; by pressure on the transverse processes; by flexion or rotation of the spine.

- b.* REFERRED PAIN, produced by pressure on nerve roots. Neuralgia of any of the spinal nerves, according to the site of the disease.

Intercostal neuralgia, or an abdominal girdle pain, are much the most frequent of these signs. In children a stomach-ache may be the only complaint.

- 2. RIGIDITY.**—Muscular rigidity in the early stages of the disease, the muscles being held rigid in order to prevent painful movement. Ankylosis produces absolute and painless rigidity later. The spine cannot be flexed or rotated: this is most marked in the upper regions of the spine. In the cervical region the head is supported by the hands.
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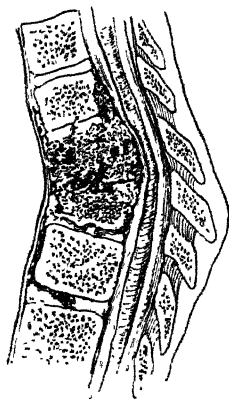


Fig. 98.—Caries of the spine. Disease starts in the body of the vertebra, destroys the intervertebral discs, spreads down the anterior common ligament, and backwards towards the cord.

In little children, place the patient on his face and lift the feet: the natural dorsiflexion which would be produced is prevented.

3. **DEFORMITY.**—Angular displacement at the site of the disease is the rule in 'central' disease. The bodies fall together, and the spinous process of the vertebra above (dorsal region) or of the vertebra below (lumbar region) forms an angle projecting backwards.

A backward curve affecting several or many vertebrae usually results from the periosteal type of disease.

No displacement at all occurs in very limited disease or in extensive disease which is quite superficial, and it is rare in cervical disease.

Compensatory curves in a forward direction occur above and below the disease in order to maintain the equilibrium of the body.

In the typical extreme angular deformity of the dorsal region, a hump is produced by it; the head is sunk low between the shoulders; the sternum is bent forwards; the ribs are crowded together, and the heart is displaced; lordosis exists in the lumbar region.

4. **ABSCCESS.**—A tuberculous suppuration forms beneath the anterior common ligament, and tracks downwards or laterally (*Fig. 99*).

IN THE CERVICAL REGION.—A retropharyngeal abscess: (a) Breaks into the pharynx; (b) The side of the neck; (c) The axilla; (d) The mediastinum.

IN THE DORSAL REGION the abscess: (a) Runs down behind the diaphragm into the psoas sheath; (b) Follows the dorsal branch of the intercostal vessels and points outside the erector spinæ; (c) Follows the main intercostal vessels and points between the ribs; (d) Very rarely tracks upwards into the neck.

IN THE LUMBAR REGION the abscess: (a) Follows the lumbar vessels, and presents outside the erector spinæ or in Petit's triangle; (b) Forms an iliac or psoas abscess.

(For further details of these abscesses, *see* pp. 6-9.)

5. **PARAPLEGIA.**—

CAUSED BY: (a) Pressure of tuberculous material upon the cord; (b) An abscess pressing upon the dura mater; or (c) Tuberculous disease of the cord or its membranes.

Rarely if ever is it the result of a narrowing of the bony canal, which is usually larger, rather than smaller, than normal.

SPECIAL FEATURES.—A zone of painful anæsthesia corresponding to the nerves at the site of disease. Motor weakness of the legs, the toes being dragged and the limbs feeling heavy and

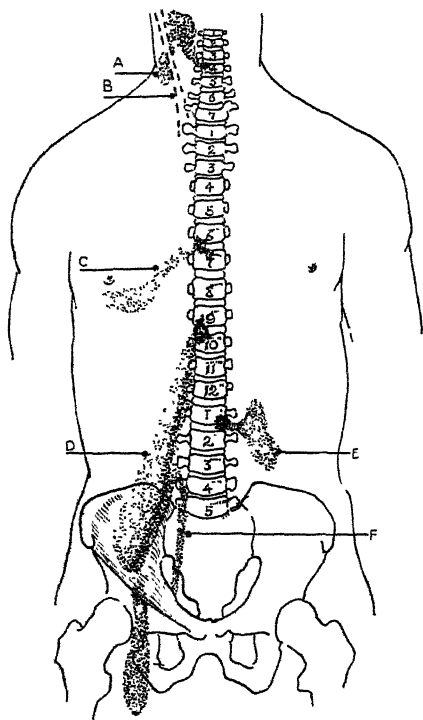


Fig. 99.—Caries of the spine. Diagram of trunk viewed from in front, showing varieties of abscess. A, Retropharyngeal abscess from cervical disease (B, Line of sternomastoid muscle); C, Abscess spreading from dorsal caries along the course of one of the intercostal spaces; D, Psoas abscess tracking down from the lower dorsal vertebrae into pelvis and thigh (F, Rare extension of psoas abscess through the sacrosciatic notch into the buttock); E, Lumbar abscess tracking backwards into the loin.

painful. Sensation is unaffected at first. The reflexes are exaggerated. Finally, complete paraplegia may result, with anaesthesia, paralysis of the sphincters, and painful involuntary contractions.

RAPID DEATH may occur from a bursting of an abscess through the dura mater producing meningitis.

SUDDEN DEATH may result from disease of the atlas or axis producing dislocation with a crushing of the cord.

Prognosis.—

GOOD as regards the prospect of life in uncomplicated cases.

BAD SIGNS and causes of death are: Abscesses which become septic—Implication of the spinal cord and its membranes—Septic sores and cystitis—Tuberculous involvement of other organs.

Diagnosis.—When pain, rigidity, and deformity co-exist, diagnosis is easy. Three groups of cases present difficulty, viz. :—

1. CASES WHERE DEFORMITY IS ABSENT, pain being the chief symptom.—

LUMBAGO, SCIATICA, NEURALGIA.—In all these marked tenderness exists on pressure over the affected muscles or nerves—No tenderness or pain on pressing on the bones—Rapid relief of pain by salicylates, etc., is often seen.

SPRAINS OR OTHER INJURIES OF THE SPINE.—In these there occur: Relation to a recent injury—Ecchymosis—Symptoms rapidly clear up with rest.

SPONDYLITIS DEFORMANS.—Affects elderly people—Is of very slow development—A large area of the spine is affected—A general kyphotic curve is produced.

SPINAL OSTEOMYELITIS.—Symptoms are very acute, with high fever.

ANEURYSM OF THE AORTA.—The pain is intense, constant, and unrelieved by rest. No tenderness exists on pressure on the bones. Other signs of aneurysm may be present.

MALIGNANT DISEASE OF THE SPINE.—This is usually secondary to some primary focus in the breast or stomach.

HYDATID DISEASE OF THE SPINE.—This is practically never diagnosed unless other circumstances, e.g., the history or previous hydatid disease, point to it.

ABDOMINAL DISEASE, especially chronic appendicitis or renal disease, is simulated by the girdle pain in children. In these there are always an absence of spinal signs and a presence of other visceral symptoms.

DISEASE OF THE SACRO-ILIAC OR HIP JOINTS.—In these, local pain, stiffness, or deformities of the affected joints are discovered on examination.

Pott's Disease—Diagnosis, *continued*.

2. CASES OF DEFORMITY IN CHILDREN.—

RICKETY KYPHOSIS.—In this the curve is a general one. Rigidity is but slightly marked. There are no specially tender points over the spine.

3. CASES IN WHICH AN ABSCESS OCCURS WITHOUT PAIN OR DEFORMITY.—These have to be distinguished from the following:—

TUBERCULOUS ABSCESSES OF OTHER ORIGIN, e.g.—

HIP DISEASE, or SACRO-ILIAC DISEASE.—The signs proper to these diseases will be present.

DISEASE OF THE ILIAC BONE.—Skiagraphy may indicate the disease, or some local tenderness may occur over the bone.

LYMPH-GLANDS (especially in the neck) forming a cold abscess.—Enlarged glands can be felt in the vicinity.

EMPYEMA.—History, signs, and symptoms of pleural and lung disease.

PYOGENIC ABSCESSES, e.g.—

PERINEPHRIC ABSCESS.

APPENDICULAR ABSCESS.

ABSCESS FROM DISEASE OF THE PELVIC ORGANS.

There will almost certainly be signs pointing to the diseased viscus, whilst the spine is mobile and free from tenderness. When these abscesses are opened they smell of the *Bacillus coli*.

In all doubtful cases the following aids to diagnosis should be used: X-ray photographs in different positions. Opsonic index in conjunction with tuberculin injections.

Treatment.—

IMMOBILIZATION.—

REST IN BED until the pain goes. This may be combined with extension apparatus or double Bryant splint (in children).

FIXATION APPARATUS for six to twelve months. Plaster jacket or metal frame (*Fig. 100*) for disease of dorsal spine. A stiff collar for cervical disease, or better, a chest jacket provided with a jury-mast from which the weight of the head is hung.

IMMOBILIZATION should be continued until all pain and tenderness have disappeared, and a supporting apparatus should be worn for at least three months longer.

SPINAL FUSION OPERATION.—When the disease is localized to one or two vertebrae, an operation which fuses the vertebrae will greatly shorten the treatment. Such an operation is most suitable for adults, and may be of two kinds: (1) *Albee's bone-graft method*. A graft is taken from the patient's tibia. About five spinous processes of the affected vertebral area are exposed and split and the bone-graft is inserted into these (*Fig. 101*). (2) *Hibbs' operation* produces spinal fusion by breaking the spinous processes and laying them down so as

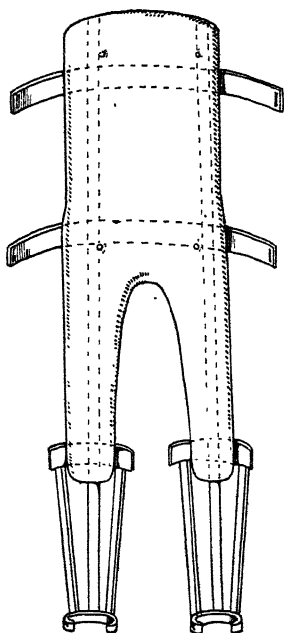


Fig. 100.—Spinal frame.

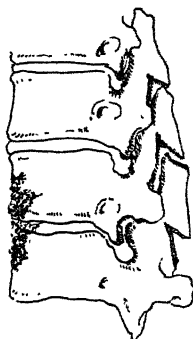


Fig. 102.—Fusion operation for caries of the spine. Hibbs' method. Fracture of spinous processes and arthrodesis of intervertebral joints.

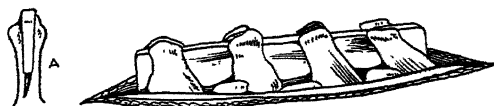


Fig. 101.—Bone-grafting for caries of the spine. Albee's method. Spinous processes are split and the graft laid in the groove so formed. 'A', Spinous process and graft seen in section.

Pott's Disease—Treatment, *continued*.

to grow together; also by doing an arthrodesis of the intervertebral joints between the laminæ (*Fig. 102*).

ABSCESSES must be treated according to general principles (*see p. 8*).

PARAPLEGIA.—

REST IN BED WITH EXTENSION should be applied directly the signs begin; this will arrest the condition in most cases.

LAMINECTOMY is done for those cases which do not improve after a month or six weeks of rest and extension.

The laminæ are removed at the site of the angle or over the spot corresponding to the highest position of the paralysed muscles. The dura is pulled to one side without opening, and the abscess sought for at the side and in front of the cord by a bent probe. If found, a soft tuberculous focus may be gently scraped out.

SPONDYLITIS DEFORMANS.

Definition.—A chronic inflammatory condition characterized by progressive kyphosis, and ending in ankylosis of the spine (poker back), which may be accompanied by acute pain referred along the spinal nerves.

Pathology.—Absorption of intervertebral discs. Synostosis of vertebral bodies. Formation and interlocking of osteophytes, and ossification of spinal ligaments.

Varieties.—There are two main types:—

1. VON BECHTEREW'S TYPE.—Affects upper cervical and dorsal regions. Associated with flattening of chest and fixation of ribs.
2. STRUMPELL-MARIE TYPE or SPONDYLOSE RHIZOMÉLIQUE.—First attacks lower portion of spine and hip, and later affects shoulder.

CHORDOTOMY.

An operation for the relief of pain associated with incurable disease in the pelvis, e.g., cancer or sarcoma. The pain fibres run in the anterolateral tracts of the cord, crossing to the opposite side. It is thus possible to divide one or both anterolateral tracts in the mid-dorsal region through a comparatively small laminectomy.

Resection of Posterior Nerve Roots (Foerster's Operation).—

This consists in division of a number of posterior nerve-roots going to the upper or lower limbs or to the intercostal nerves. It was suggested for the relief of pain, spasticity, or visceral crises. But the operation had a high mortality and gave very uncertain results, so that it has been superseded by the operations of chordotomy and those on the sympathetic nerves (*see Chapter XVII*).

CHAPTER XXVII.

HEAD INJURIES.**INJURIES OF THE SCALP.**

Abscess or Hæmatoma of the Scalp may follow injury.

1. **SUPERFICIAL TO APONEUROSIS.**—Small and ill-defined. Trivial.
2. **SUB-APONEUROTIC.**—Large and ill-defined. Only limited by attachments of occipito-frontalis. If septic, may be fatal.
3. **SUB-PERICRANIAL (CEPHALHÆMATOMA).**—Limited to one or other skull bone owing to pericranium dipping between sutures. Commonly seen in birth injuries. May be associated with underlying fracture. Closely resembles depressed fracture of skull.

TREATMENT.—Open the inflammatory, but leave the blood swellings alone.

Wounds of the Scalp may be incised, lacerated, or punctured.

Three features require special note :—

HÆMORRHAGE is very free, either from partial division of an artery or from the difficulty of securing a wounded vessel in the dense tissues of the scalp. It is often necessary to pass a suture through whole thickness of scalp to stop bleeding.

SEPSIS is frequent from the hair and hair follicles, and readily leads to cellulitis.

The neighbourhood of all wounds should therefore be freely shaved.

AVULSION of part or the whole of the scalp may occur, especially in women, from entanglement of hair in machinery.

If the separated part can be found, and is fairly clean, it should be replaced and sutured, and has then a fair chance of re-union. Otherwise extensive skin-grafting will be required.

Cellulitis of the Scalp is of serious import, for the following reasons :—

1. **EXTENT.**—It rapidly spreads beneath the aponeurosis so as to extend from the forehead to the occiput.
2. **MENINGEAL INFECTION** readily occurs by extension through the veins and lymphatics through the skull.
3. **CRANIAL OSTEOMYELITIS** may result by infection of the veins of the diploë.

TREATMENT must be by early multiple incisions in the most dependent situations, free drainage, and repeated fomentations.

Traumatic Cephalhydrocele.—Occurs in children, but is very rare. Fluctuating fluid swelling under the scalp. Communicates with subarachnoid space or lateral ventricle through a fracture in the vault. Pulsates with the heart and respiration.

FRACTURES OF THE SKULL.

Mechanical Factors.—The skull being an elastic sphere is capable of some yielding to a blow. This involves a bending in at the point of contact and at the opposite pole, and a bulging out at the equator between these poles. Thus, all cranial fractures may be divided into :—

1. **BENDING FRACTURES.**—Occurring at the point of impact and at that opposite to it, from compression at the poles. Commoner at the vault. THE INNER TABLE suffers more than the outer, and over a wider area. It may be the only part fractured. In infants and the aged, in whom no diploë exists, the vault only breaks in one piece.
2. **BURSTING FRACTURES.**—Caused primarily by expansion between the poles of impact and resistance. Occur as radiating fissures. Commoner at the base, where thin areas and foramina lie between thick resistant areas. The fissures run most commonly down the temporal fossa of the vault into the middle fossa of the base and across the sella turcica. This area lies between the strong buttresses formed by the external angular process of the frontal and lesser wing of the sphenoid in front and the mastoid and petrous bones behind.
3. **PUNCTURED FRACTURES.**—These may be considered here under the commonest variety, viz. :—

Gunshot Fractures.—The path of the bullet may be directly perforating or tangential.

IN PERFORATING FRACTURES, the table last traversed is most injured ; thus, at the wound of entry the inner table is most broken, and at the wound of exit the outer.

THE EXPLOSIVE EFFECT of the hydrodynamic force transmitted to the fluid brain by the bullet causes a bursting fracture with much comminution.

EFFECT OF VARYING FORCE.—A modern rifle at close range causes extensive comminution ; at about a mile, simple perforation ; a rifle beyond a mile, or a pistol, may not penetrate, or the bullet may lodge.

PROGNOSIS.—About 45 per cent are fatal.

TREATMENT should be on general lines, according to brain symptoms. Attempts to probe for and remove bullet should never be made unless there are definite symptoms of local irritation.

General Considerations.—

RELATION BETWEEN BASE AND VAULT FRACTURES.—The majority of fractured vaults have also a fractured base. Basal fractures often occur alone.

IMMEDIATE MORTALITY.—About one-third die within forty-eight hours from cerebral complication.

LATE MORTALITY.—Immediate survivors often die of meningitis.

REPAIR OF CRANIAL FRACTURES is slow, incomplete, or fibrous.

FRACTURES OF THE VAULT.

Varieties.—Fissured (no symptoms or signs unless compound)—Depressed—Punctured. (*See also Fig. 103.*)

Depressed and Punctured Fractures.—Generally comminuted. In children depression may exist without fracture. Outer or inner table may alone be broken.

Inner table is generally much more broken than outer because it is less supported; it is broken by a force of less momentum; the breaking force is radiated over a wider area.

VARIETIES.—

CLOSED (SIMPLE) OR OPEN (COMPOUND).

POND.—No sharp depressed edge.

GUTTER.—With sharp depressed edge.

GUNSHOT.—Wound of entry has inner table most damaged.

Wound of exit has outer table most damaged. May be associated with fractured base.

Symptoms.—

1. CONCUSSION from the blow.
2. COMPRESSION from pressure of bone or exudate.
3. May be NO CEREBRAL SYMPTOMS at all.
4. IF OPEN and SEPTIC: Symptoms of septic infection—Necrosis of bones or osteomyelitis, pyæmia—Epidural or subdural abscess—Meningitis—Cerebral abscess—Late cerebral compression—Possibly hernia cerebri.

Treatment.—

The general treatment and the operative treatment for signs of compression are the same as for fractured base (*see below*).

WOUNDS associated with compound fractures must be carefully cleaned, with free scalp shaving.

IN COMMINUTED AND PUNCTURED FRACTURES, remove loose spicules of bone, especially those of the inner table. Remove subdural clots if these are present.

IN ALL DEPRESSED FRACTURES (except the pond-shaped fractures in infants, which undergo spontaneous restitution) trephine beyond the fracture and elevate. Remove loose bone from the inner table.

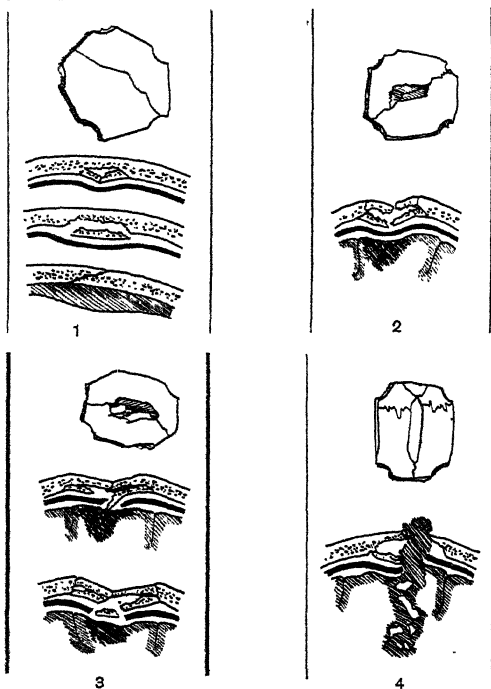
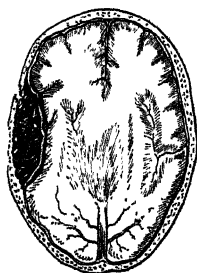


Fig. 103.—Fractures of the cranial vault (after Cushing). 1, Simple fracture, with splintering of the inner table; 2, Fracture of both tables, with contusion of the brain; 3, Fracture of both tables, with laceration of the dura; 4, Fracture of skull, laceration of dura, with particles of bone driven into the brain.

Fig. 104.—Head shown in horizontal section. There is a fracture of the skull, with a subcranial or extradural hæmorrhage between the bone and dura, from a laceration of the middle meningeal vessels. Note the compression of the brain.



Birth Fractures.—Depressed or fissured.

DEPRESSED.—Due to forceps. Signs and symptoms vary according to depth of depression. May be concealed by cephalhæmatoma.

TREATMENT.—Leave alone if slight and over the silent area.

Elevate the others.

FISSURED.—Due to falls or blows. Differ from those of adult in that the width of the fissure tends to increase owing to increasing intracranial pressure from growth of brain, and traumatic cephalocele may result.

FRACTURES OF THE BASE.

Causes.—

INDIRECT VIOLENCE, acting on the vertex.—By radiation of fracture from the vertex. By compression of the elastic skull, causing it to burst at the weak points at the base.

DIRECT VIOLENCE.—Penetrating wounds through orbit or nose. Blows transmitted through condyles of jaw. Violence transmitted through the vertebral column.

Position of Fractures.—Generally transverse through the fossæ. Often run right across the base. Often run from one middle fossa to the opposite anterior or posterior fossa. Generally traverse the nerve foramina. Petrous bone is often involved.

Varieties.—

CLOSED.—Especially in the posterior fossa.

OPEN.—The commonest variety.

IN ANTERIOR FOSSA.—Into nose or orbit.

IN MIDDLE FOSSA.—Into external or middle ear; into nasopharynx; into sphenoidal sinuses.

IN POSTERIOR FOSSA.—Into nasopharynx.

Brain may be concussed, contused, or lacerated.

COMPLICATED.—

MENINGES may be lacerated. Meningitis, simple or septic, may follow.

VESSELS may be contused, with resulting thrombosis, or lacerated.

Venous sinuses—subdural hæmorrhage.

Middle meningeal artery—extradural hæmorrhage (*Fig. 104*).

Internal carotid artery—aneurysm or fatal hæmorrhage.

NERVES may be damaged or torn: Sensory loss—Paralysis.

Signs of Fractured Base.—

DIRECT SIGNS of fracture.—Crepitus is very rare. Only present when comminution exists or when cranium is divided into two parts. Should never be sought for.

USUAL SIGNS are those of the complications.—

1. **CEREBRAL CONCUSSION** or **LACERATION.**—Usually prolonged coma.

2. **HÆMORRHAGE.**—

BLEEDING FROM THE NOSE.—From fracture of ethmoid

Fractures of Base of Skull—Signs, *continued*.

(anterior fossa); basi-sphenoid (middle fossa); basi-occipital (posterior fossa). May be swallowed and then vomited.

ORBITAL HÆMORRHAGE (anterior fossa).—Ecchymosis (chiefly of the lower lid). Subconjunctival (below the cornea without posterior limit). Proptosis. Orbital aneurysm—internal carotid artery and cavernous sinus both injured.

FROM EAR (middle or posterior fossa).—Laceration of small vessels in middle ear, together with rupture of drum. Injury of internal carotid or one of the venous sinuses. Injury of drum, cartilage, or meatus may cause slight bleeding independently of fractured base.

INTO MUSCLES AT BACK OF NECK (posterior fossa).—Shown by ecchymosis.

3. **DISCHARGE OF CEREBROSPINAL FLUID.**—From the nose, or more commonly the ear. Caused by laceration of dura, generally in the internal meatus. Large quantity (one or more pints).

Fluid with the following characters: Sp. gr. 1005—Alkaline—Does not coagulate on boiling—Reduces copper.

4. **ESCAPE OF BRAIN SUBSTANCE FROM THE EAR.**—Rare and only in fatal cases.

5. **NERVE LESIONS.**—

Optic nerve or tract: rare. Blindness.

Third, fourth, sixth nerves: common. Ocular paralysis.

Seventh and eighth: the commonest of all. Facial paralysis and deafness.

Ninth, tenth, eleventh, and twelfth: rarely involved.

Lesion may be immediate, from rupture, often permanent; or later from callus involvement, generally recovers.

Prognosis of recovery is that of the complications. The majority of deaths occur within forty-eight hours of injury. If marked improvement does not occur before this time the prognosis is grave. Thus, in uncomplicated cases it is good; in cerebral lesions, in rupture of large vessels, and in septic complications (meningitis or abscess) it is bad.

Prognosis of Completeness of Recovery is seldom good, because of the sequelæ.

Treatment.—Disinfection and dressing of the external auditory meatus. Shave the head. Apply cold by ice-bags or Leiter's tubes. Keep at absolute physical and mental rest for six weeks. No mental work for three to six months.

OPERATIVE TREATMENT.—If signs of compression are well marked or increasing during the second day, a subtemporal removal of bone should be performed, if necessary on both sides. The dura is opened and the subdural space drained. (See CEREBRAL COMPRESSION, p. 326.)

**INTRACRANIAL COMPLICATIONS OF
HEAD INJURIES, ETC.****Varieties.—**

CEREBRAL.—(1) Concussion; (2) Irritation; (3) Contusion; (4) Compression; (5) Laceration.

INFLAMMATORY.—(1) Subcranial abscess; (2) Meningitis; (3) Sinus thrombosis; (4) Cerebral abscess.

HÆMORRHAGE.—(1) Venous sinuses; (2) Extradural vessels; (3) Subdural; (4) Subarachnoid; (5) Cerebral.

CEREBRAL LESIONS.**Cerebral Concussion.—**

PATHOLOGY.—Engorgement of viscera. Ecchymosis of brain, but no other macroscopic change.

Theories as to cause: (1) Molecular disturbance of brain cells; (2) Multiple minute contusions; (3) Paralysis of vasomotor centre produced by a sudden acute cortical anæmia. The latter is probably correct.

SYMPTOMS.—

UNCONSCIOUSNESS, partial or complete.

PUPILS equal, contracted, and reacting. In fatal cases they are equal, dilated, and fixed.

SURFACES pale, cold, clammy.

RESPIRATION slow, shallow, irregular.

TEMPERATURE subnormal.

PULSE weak, rapid, and irregular.

REFLEXES present in all but worst cases.

BLADDER AND RECTUM unaffected except in worst cases.

FOLLOWED BY one of the following conditions:—

1. **REACTION.**—Return of consciousness. Rise of temperature to 101° – 102° . Headache and vertigo. Vomiting. Some irritability. Later for some days there may be a subnormal temperature and slow pulse.

2. **DEATH.**—Deepening unconsciousness. Temperature rises to 104° or over.

3. **CEREBRAL IRRITATION, INFLAMMATION, OR COMPRESSION.**

TREATMENT.—Rest in bed for several weeks. Ice-cap to the head. Light diet.

Cerebral Irritation.—This is a clinical rather than a pathological conception. It is associated with certain cases of concussion, especially with those where contusions of the frontal and occipital regions have occurred.

SYMPTOMS.—The symptoms of concussion gradually give place to the following: Great mental irritability whenever aroused from drowsy stupor. Headache. The patient lies curled up in a position of general flexion. The drowsiness of concussion gives place to restlessness or delirium. The pulse and respiration are irregular. The irritability is succeeded by fatuity.

Cerebral Irritation, continued.

TREATMENT.—As for concussion, but these cases especially require prolonged mental and physical rest, in order to prevent permanent mental or epileptic symptoms.

Cerebral Contusion.—This is practically a severe grade of concussion or a slight grade of laceration.

THE USUAL SITES are at the tip of the temporal lobes and the under side of the frontal lobes, often produced on the side opposite to the blow by *contre-coup*.

SYMPTOMS.—Those of concussion, but more prolonged in duration, and nearly always succeeded by some degree of compression or irritation. Convalescence is prolonged, and sequelæ are more marked than with simple concussion.

LUMBAR PUNCTURE shows blood in the cerebrospinal fluid.

TREATMENT.—Rest in bed, until headache, slow pulse, and retinal stasis have disappeared.

Cerebral Compression.

CAUSES.—Depressed fractures—New growth of bone—Blood (extradural, subdural, intracerebral)—Edema—Pus (extradural, subdural, cerebral abscess)—Tumours.

PHYSIOLOGY.—There are two types of compression of the brain :—

1. LOCAL, e.g., that caused by a tumour, which is grave in proportion to its proximity to the medulla.
2. GENERAL, e.g., that of hydrocephalus, in which the whole intracranial circulation is affected.

CIRCULATORY CHANGES.—The cerebrospinal fluid is first driven out. Then the blood-vessels are compressed, the veins suffering first because of their thin walls and low blood-pressure. Venous stasis is succeeded by capillary anæmia. This causes loss of function in the anæmic parts, and death if these be the vital centres in the medulla.

DIVISION OF THE CRANIAL CAVITY.—The cranial cavity is divided by the falx and tentorium into three spaces, and thus a local compression may reach a high degree before causing general compression. Subtentorial compression is the most important, because the condition of the medulla is the crux of the situation.

COMPENSATORY MECHANISM.—If subtentorial pressure exceeds that in the arteries, death must result from anæmia of the medulla. But the early stages of stasis or slight anæmia stimulate the vasomotor centre, and the blood-pressure is raised. This goes on until the blood-pressure may be twice as high as normal. At last the blood-pressure can rise no longer, intracranial pressure is the higher, and death results.

FLUCTUATIONS IN BLOOD-PRESSURE.—There is a regular oscillation in blood-pressure as the pressure in the cranium and in

the vessels of the vasomotor centres are balancing one another. Hence the alternations of blood-pressure and of respiratory rhythm, which correspond to these changes in the medullary circulation. This explains Cheyne-Stokes respiration.

SYMPTOMS.—

1ST STAGE—Compensation. Symptoms are few. Headache, with mental dullness.

2ND STAGE—Venous stasis. Severe headache, with drowsiness or restlessness. Congestion of the vessels on the scalp and eyelids. The fundus oculi shows swelling and enlarged tortuous veins. The pulse is slow and the blood-pressure rises.

3RD STAGE—Cerebral anæmia. Unconsciousness absolute.

RESPIRATION slow, laboured, and stertorous. Cheeks puffed out. Soft palate paralysed. Cheyne-Stokes breathing in bad cases.

PULSE full, slow. Blood-pressure is high.

TEMPERATURE generally raised. More on the paralysed side than the other.

PUPILS unequal and fixed. Each first contracts, then dilates; first the one on side of lesion, then the opposite. Choked disc.

MOTOR PARALYSIS, generally hemiplegic.

BLADDER paralysed, retention.

RECTUM.—Sphincter paralysed.

REFLEXES DIFFER on two sides generally. On paralysed side they are increased.

4TH STAGE—Medullary paralysis.

The respiration fails first, and then the pulse becomes rapid and weak. The pupils are widely dilated and fixed.

The blood-pressure falls and death occurs.

TREATMENT.—

GENERAL TREATMENT as for concussion.

LOCAL COMPRESSION.—Remove the cause if possible, e.g., by elevating fractures, removing blood-clots or tumours, opening abscesses, etc.

INTRAVENOUS INJECTION OF HYPERTONIC SALINE.—Inject 30 c.c. of a 30 per cent solution of sodium chloride into a vein. This reduces the intracranial tension and so relieves headache and coma. The relief is almost immediate and lasts 12 to 36 hours.

VENESECTION is a time-honoured remedy of great danger. It lowers the blood-pressure, and so weakens the compensatory mechanism which prevents the medulla from becoming anæmic.

LUMBAR PUNCTURE is also dangerous, because the cerebellum and medulla become crowded down into the foramen magnum, and sudden death has thus often resulted.

Cerebral Compression—Treatment, continued.

SUBTEMPORAL DECOMPRESSION.—This should be carried out in all cases where a local cause cannot be removed, and in which the symptoms are those of the third stage. The temporal muscle is split, a piece of bone about $1\frac{1}{2}$ in. in diameter is removed towards the base of the skull, the dura is opened, and a drain inserted. It may be done on both sides.

Cerebral Laceration.—**CAUSES.—**

1. Blows on the head. Common complication of fractures of the skull. Occurs either: (a) Beneath point struck; or (b) At point opposite from *contre-coup*.
2. PENETRATING WOUNDS, with compound fracture.

ANATOMY.—

IMMEDIATE.—Laceration or pulping of nerve substance—Pial hæmorrhage—Ecchymosis in brain substance—Bleeding may be into the ventricles.

LATER.—Local œdema—Spreading œdema, with increase of the cerebrospinal fluid—Red softening—Yellow softening, or rarely an arachnoid cyst.

SYMPTOMS.—There are none which are really peculiar to laceration, but the following conditions are strongly suggestive of it:—

1. Symptoms of concussion, merging into those of compression.
2. Symptoms of concussion, with coma which does not lessen.
3. Symptoms of concussion, followed by those of irritation.
4. Convulsions affecting regular groups of muscles, leaving convulsed parts paralysed, and spreading in a regular sequence.
5. Temperature rising to 104° F. or over is suggestive of laceration of a severe kind.

INTRACRANIAL INFLAMMATION.

VARIETIES.—**SUBCRANIAL** (abscess or pachymeningitis); **MENINGITIS** (acute or chronic, diffuse or local); **INFECTIVE THROMBOSIS** of the sinuses; **ABSCESS** in the brain substance.

Subcranial Abscess.—Pus collects between bone and dura mater.

CAUSES.—Septic open fracture. Septic scalp wound and osteomyelitis. Contusion followed by auto-infection. Middle-ear disease.

SIGNS AND SYMPTOMS.—Symptoms of suppuration. Compression of the brain. Unhealthy wound with dead bone or œdematous patch on scalp (Pott's puffy tumour). Localized headache and tenderness. Paralysis or spasm if over motor area.

TREATMENT.—Trephine, evacuate, and drain

Meningitis.

Pachymeningitis.—Local thickening of dura. Probably follows contusion or fracture. Fixed headache, with possibly Jacksonian epilepsy.

Acute Meningitis may be primary and idiopathic, or secondary and septic.

Primary Idiopathic Meningitis occurs as epidemic cerebrospinal fever, due to *Diplococcus intracellularis*. In infants sporadic cases of posterior basic meningitis occur, due to same organism.

SYMPTOMS.—Acute onset, with headache and rigors, vomiting, photophobia, and optic neuritis. Marked retraction of the head and spasms of the limbs. If not immediately fatal it leads to acute hydrocephalus or epilepsy.

TREATMENT by repeated lumbar puncture and by ventricular punctures if hydrocephalus has occurred.

Acute Septic Meningitis.—Infection by pyogenic cocci, those secondary to fractures of the vault being usually streptococcal, and those following basal fractures pneumococcal, from infection through nasal sinuses.

CAUSES.—Septic wounds of the scalp or orbit. Suppuration in nasal cavities or sinuses. Infection from pharynx or fauces. Extension from otitis media.

SYMPTOMS.—Rapid onset of symptoms forty-eight hours after injury. Severe headache. Vomiting of cerebral type. Photophobia. Cerebral irritability, followed by delirium with sharp cry, and later by signs of cerebral compression. Spasm and twitchings of muscles. Retraction of the head. High temperature, initiated by a rigor.

IN MENINGITIS OF THE CONVEXITY.—Convulsions affecting special groups of muscles.

IN MENINGITIS OF THE BASE.—Optic neuritis—Strabismus, from paralysis of motor nerves—Marked retraction of the head.

LUMBAR PUNCTURE is of great value both for diagnosis and treatment. Performed between the 3rd and 4th lumbar spines. The cerebrospinal fluid escapes with a jet as if under pressure. It contains many lymph-cells—chiefly polymorphs in septic meningitis and lymphocytes in tuberculous cases. Also the causative bacteria, from which a vaccine may be prepared. In posterior basic cases the fluid is often sterile.

ANATOMY.—Vascular engorgement of dura and pia mater, cerebral substance, and choroid plexuses. Arachnoid is thick and opaque. Turbid serum or pus occupies the subarachnoid space. Convolutions are flattened. Ventricles are distended.

TREATMENT.—Rest and treatment of the general febrile condition. Cold to the head. Repeated lumbar puncture.

Acute Septic Meningitis—Treatment, *continued*.

SUBOCCIPITAL DRAINAGE through a trephine opening near the middle of the occipital bone below the inion is the last resort in cases in which, owing to adhesion, the fluid will not escape into the spinal theca for lumbar drainage.

Chronic Meningitis may be traumatic or syphilitic.

CAUSED BY a local head injury.

CONSISTS OF a thickened patch of membranes. May be adherent to the bone above or to the brain below.

SYMPTOMS.—Headache, constant, fixed, and localized—Local tenderness—Possibly traumatic epilepsy—Mental instability—Alcoholism

TREATMENT.—Prolonged rest. Absence of excitement. Abstinence from alcohol. Blistering the scalp. Small doses of mercury. Trephine if locality is definite.

Syphilitic Meningitis.—A severe headache is associated with a variety of mental symptoms and cranial nerve paralyses. The symptoms are intermittent in severity.

TREATMENT.—Six weeks' medicinal treatment should be tried first. If this does not effect a great improvement, an attempt should be made to remove any localizable thickenings, or to perform a decompressive operation.

Infective Thrombosis of the Cerebral Sinuses.

CAUSES.—Middle-ear disease (lateral sinus). Septic wounds of scalp or orbit. Septic states of nose or pharynx. Erysipelas or cellulitis of face or scalp. Osteomyelitis of cranial bones.

VARIETIES.—Lateral sinus—much the commonest—infected from the ear. Cavernous sinus—next commonest—infected from nose, face, or orbit. Longitudinal sinus—rare—infected from the scalp, face, or nose.

ANATOMY.—Sinus is plugged by soft, adherent, septic blood-clot. Portions of the infected clot form septic emboli. Emboli cause pulmonary infarctions and abscesses. Inflammation of the bone, meningitis, or abscess are probable complications.

SYMPTOMS AND SIGNS.—Existence of some primary septic focus.

HEADACHE.—Sudden and severe. Localized tenderness over the affected sinus.

REPEATED VOMITING.

TEMPERATURE rises to 103° – 105° , with a bad rigor; continuous, with remission and REPEATED RIGORS. Dyspnoea and cyanosis are marked during the rigors.

PULSE is full, slow, and compressible, but becomes rapid during the rises of temperature.

LOCAL pain and other signs in the lungs may point to the existence of INFARCTIONS.

MENTAL CONDITION.—Drowsy or delirious.

OPTIC NEURITIS AND STIFFNESS OF NECK MUSCLES point to meningitis.

IN LATERAL SINUS THROMBOSIS.—Discharge from the ear ceases. Tender swelling over the jugular vein. Dusky congestion of the side of the face. An abscess may form in the neck. Rarely the nerves emerging from the jugular foramen may be affected, producing hoarseness, dysphagia, dyspnoea, or slow pulse.

IN CAVERNOUS SINUS THROMBOSIS.—Marked exophthalmos, with great orbital congestion. Chemosis, choked disc, retinal hæmorrhages, ocular paralysis, with hyperæsthesia of first division of fifth nerve and occasional herpes. May become double by extension of the thrombosis across the pituitary sinuses.

IN SUPERIOR LONGITUDINAL SINUS.—Turgescence of the scalp and forehead. Tenderness over the sinus. Convulsions of one or both legs.

TREATMENT.—

FOR LATERAL SINUS.—Trepine on Reid's base-line, $\frac{3}{4}$ in. behind external auditory meatus. Tie internal jugular vein first if diagnosis is certain. Turn out the clot. Perform a radical mastoid operation if necessary. Plug.

FOR LONGITUDINAL SINUS.—Trepine above the torcular.

Abscess of the Brain.

CAUSES.—

1. **TRAUMATISM**, e.g., fracture or penetrating wound.
Early after injury—superficial, contiguous to bone.
Late after injury—deep in white matter of the frontal or parietal lobes.
2. **INFECTION FROM NEIGHBOURING SEPTIC FOCI.**—
Middle-ear disease, usually of the chronic type: Generally in cerebellum or temporosphenoidal lobe, the latter being about twice as common as the former. Sepsis may spread by direct continuity through bones and membranes. More commonly spreads by vessels and occurs beneath the surface.
Disease of frontal, sphenoidal, or ethmoidal sinuses.
Thrombosis of venous sinuses.
3. **BLOOD INFECTION IN PYÆMIA** or exanthemata.
Septic lung diseases, e.g., gangrene or bronchiectasis.
Osteomyelitis
Septic endocarditis.
4. **TUBERCLE** may cause a chronic abscess.

ANATOMY.—Generally single and often of a chronic type having a well-marked capsule. May burst into ventricles or subarachnoid space, or cause œdema of brain. The pus is usually offensive, and contains the usual pus cocci or pneumococci.

SYMPTOMS.—

DISCHARGE from the ear ceases.

HEADACHE.—General at first; fixed and localized later; often intermittent.

MENTAL CONDITION.—Drowsiness, with irritability.

TEMPERATURE normal, or often subnormal.

Abscess of the Brain—Symptoms, continued.

VOMITING is frequent. Anorexia, malaise, and constipation.

OPTIC NEURITIS.

COMPRESSION SIGNS.—Slow or intermittent pulse. Laboured breathing—Cheyne-Stokes type later. Torpor is succeeded by coma. Pupil on the side of lesion is dilated and fixed.

LATENCY, with absence of some or all symptoms, is common.

FOCAL SIGNS (rare) —

Temporosphenoïdal.—Paralysis or spasm of the opposite side of face; aphasia if the left side is affected.

Cerebellum.—Giddiness and tendency to fall towards the lesion. Nystagmus and deviation of eyes to the same side (*see* p. 349—FOCAL SYMPTOMS IN DISEASE OF CEREBELLUM). Paralysis of the arm on the same side.

TREATMENT.—Turn down flap of soft parts. Trephine the bone with a 1-in. trephine. Make crucial incision through the dura. Probe for pus. Enlarge opening with sinus forceps. Drain and gently wash out. Pack gauze round the drain.

For temporosphenoïdal abscess: $\frac{3}{4}$ in. above external auditory meatus.

For cerebellar abscess: $1\frac{1}{2}$ in. behind external auditory meatus and 1 in. below base-line.

For combined operation: 1 in. behind external auditory meatus, $\frac{1}{2}$ in. above base-line. Lateral sinus lies in trephine opening. Enlarge upward and forward for temporosphenoïdal abscess; downward and backward for cerebellar.

If secondary to mastoid disease: open mastoid and follow track to abscess.

DIAGNOSIS OF SOME FORMS OF INTRACRANIAL INFLAMMATION AND COMPRESSION.

PRELIMINARY NOTE.—Two or more inflammatory lesions often co-exist, e.g., thrombosis and abscess, or thrombosis and meningitis, etc.

MENINGITIS.—Sudden onset. Cerebral irritation well marked (delirious cry, photophobia, contracted pupils). Rigidity of neck. High temperature without marked remissions. Early development and rapid course. Optic neuritis if base is affected. Great increase of polymorphs in fluid from a lumbar puncture.

THROMBOSIS.—Sudden onset. Is associated with suppurating focus. Rigors repeated. Temperature high but intermittent. Tenderness in the neck. Pulmonary signs.

SUBCRANIAL ABSCESS.—Local pain, tenderness, and œdema-tous swelling. Compression symptoms steadily increase. High temperature.

CEREBRAL ABSCESS.—Normal or subnormal temperature. Headache may be the only symptom. Vomiting and optic neuritis. Late onset and of slow development.

CEREBRAL TUMOUR.—Headache, vomiting, optic neuritis (may be the only symptoms). Symptoms develop slowly, but without remission. Absence of septic focus. Absence of general malaise in the early stages.

INTRACRANIAL HÆMORRHAGE.

VARIETIES.—(1) **Extradural**—between the dura and cranium; (2) **Subdural**—between the dura and arachnoid; (3) **Subarachnoid**—between the arachnoid and pia; (4) **Cerebral**—in the substance of the brain.

Extradural or Subcranial Hæmorrhage.—

CAUSES.—Ruptured middle meningeal artery in the great majority of cases. Rupture or wounds of the venous sinuses or other meningeal vessels. Rarely in the frontal and occipital regions. Extradural hæmorrhage is very rare in infants or aged people, because in both these the dura is so closely attached to the skull.

MECHANISM.—The middle meningeal artery runs in a deep groove or tunnel in the sphenoid, temporal, and parietal bones, and therefore is often torn in fractures of the base or vertex, or by a blow which separates the dura without fracturing the skull. May be on the side opposite to the blow. Usually the anterior branch which suffers. The blood collects between the dura and the skull, driving the former in upon the brain (*see Fig. 104, p. 322*).

SYMPTOMS.—Typically there are three stages:—

1. Concussion from the blow, with signs and symptoms of fractured skull; blood-pressure is low and hæmorrhage is slight.
2. Recovery from unconsciousness, with improving pulse. The blood-pressure rises, and bleeding strips the dura from the bone.
3. Gradual coma from cerebral compression by the blood-clot. This comes on within a few hours or days of the return to consciousness. Retinal congestion with choking of the disc is one of the earliest signs, and occurs first and in most marked degree on the side of the lesion.

Or in bad cases the signs of concussion may merge into those of compression without a conscious interval.

Convulsions and paralysis of the arm and face on the opposite side may occur as the coma sets in. Aphasia may occur in left-sided injuries.

Congestion of the eye of the same side, with proptosis and ocular paralysis, may result from pressure on the cavernous sinus. Swelling and ecchymosis of the temporal fossa occur from co-existing injury or from leaking of blood through a fracture.

DIAGNOSIS.—Is only possible when the typical sequence of symptoms occurs.

From **INTRAMENINGEAL HÆMORRHAGE** by the delayed onset of coma.

Extradural or Subcranial Hæmorrhage—Diagnosis, *continued*.

From CEREBRAL LACERATION by the absence of marked rise of temperature. But this diagnosis is often impossible.

Also a lumbar puncture withdraws clear fluid containing no blood-corpuscles.

TREATMENT.—Trephine and clear out the blood-clot, plugging or tying the meningeal artery. This should not be delayed longer than forty-eight hours after the injury.

PROGNOSIS is bad, because the operation is usually delayed too long, so that the compressed brain cannot recover.

Intrameningeal Hæmorrhage (including subdural and sub-arachnoid bleeding).—

CAUSES.—Injuries of the meningeal vessels, especially those of the pia mater, also of the venous sinuses, by punctured wounds or fractures of the skull.

ANATOMY.—The blood is spread out between the brain and the dura, compressing the former. If the case recovers, the blood is absorbed and an ARACHNOID CYST left.

SYMPTOMS are those of cerebral compression coming on directly after an injury. Convulsions and paralysis occur if the motor area of the cortex is affected. Late paralysis or Jacksonian epilepsy may occur from the presence of adhesions or a cyst.

DIAGNOSIS is almost impossible from severe concussion and laceration of the brain.

Spinal fluid from a lumbar puncture contains blood-cells.

TREATMENT.—All cases in which coma lasts more than twenty-four hours should be trephined in the subtemporal region on both sides if necessary. If the dura is found to be blue and bulging, it is opened, the blood and clot are removed, and a drain is inserted.

Cerebral Hæmorrhage.—The chief importance of this is its recognition as differing from other forms of bleeding which are amenable to surgical measures. Usually it occurs apart from trauma in cases of Bright's disease or high arterial tension. Localized focal signs of hemiplegia are more marked than the other signs of compression.

Intracranial Hæmorrhage in the New-born.—

CAUSES.—The moulding of the soft cranial bones during difficult labour. The pressure of obstetric forceps.

ANATOMY.—The over-riding of the edges of the parietal bones tears the veins which enter into the superior longitudinal sinus. The blood is poured out over the surface of the brain in the region of the median longitudinal fissure or over one or both hemispheres.

SYMPTOMS.—Asphyxia or delayed and irregular respiration. The anterior fontanelle is tense, bulging, and pulsates feebly. The scalp and eyelid vessels are dilated. The pupils are unequal.

Convulsions are common and often fatal. Paralysis of cortical origin is not seen in infants.

RESULTS.—The majority die within a few days of birth from convulsions or respiratory failure. In the survivors, various birth palsies (Little's disease) develop in later life, with dementia or idiocy. Bilateral spastic paralysis of the legs is common from involvement of both leg centres near the longitudinal fissure. Spastic diplegia occurs when both arm and leg centres on the same side are involved.

TREATMENT.—A large part of one parietal bone should be turned down on a lateral hinge. The dura is opened and the clots are removed. A lumbar puncture may be necessary to relieve tension sufficiently to close the dura.

REMOTE RESULTS OF HEAD INJURIES.

PERCENTAGE.—About half of all cases of fractured skull and concussion show some slight permanent sequelæ. Ten to twenty per cent have a marked after-effect. Nearly 10 per cent develop traumatic insanity.

DISPOSITION to mental after-effects is determined by : (1) Natural temperament; (2) Alcoholic habits; (3) Youth or old age; (4) Efficiency of treatment—operation, and long rest afterwards, lessening the chances of after-effects.

Remote Symptoms.—

1. **GENERAL CEPHALALGIA.**—Constant dull pain over frontal, vertical, or occipital regions.
2. **LOCAL CEPHALALGIA.**—Headache with local tenderness. May be due either to osteosclerosis (when it is cured by trephining), or meningeal adhesions.
3. **PAINFUL SCARS.**—Caused by the adhesion of the scalp to the cranium.
4. **VERTIGO.**—Is left in 22 per cent of fractured skulls, and is due to cerebral instability.
5. **VOMITING** is often associated with the vertigo.
6. **MENTAL CHANGES.**—(a) Melancholia, suicide (1-2 per cent); (b) Irritability; (c) Loss of 'nerve'; (d) Inability for mental exertion; (e) Disturbed sleep; (f) Liability to alcoholism and sunstroke.
7. **MOTOR APHASIA** only follows injuries to Broca's centre.
8. **AMNESIA**, or loss of memory, occurs very commonly (35 per cent) in a slight degree. It results from mental instability and failure of power of attention. It may be one of three types : (a) Loss of memory of the accident and the following days : this is usual. (b) Loss of memory of the life previous to the injury : this is rare. (c) Loss of memory for events subsequent to the injury : this is common.

Results of Head Injuries—Remote Symptoms, *continued*.

9. SPECIAL NERVE INJURIES.—Loss of smell, inequality of pupils, accommodative asthenopia, nystagmus, optic atrophy, deafness (12 per cent), increased knee-jerks, slow pulse.
10. GLYCOSURIA.—Temporary is common. Permanent very rare. More frequently follows injuries of the back of the head.
11. HEMIPLEGIA.—Primary, or secondary from scar, cyst formation, or sclerosis.
12. TRAUMATIC EPILEPSY.—Occurs in 7 per cent of fracture cases. The majority are idiopathic or general epilepsy, but one-third are of a Jacksonian type.

In Jacksonian or traumatic epilepsy, the convulsions precede loss of consciousness, and the latter may be slight or absent. The convulsions usually begin in the same group of muscles, i.e., in those related to the affected cortical centre. From this group the convulsions spread to neighbouring groups until, in bad cases, they may become general. The muscles first convulsed remain paralysed for some time after each convulsion.

PROPHYLAXIS.—If all depressed fractures and punctured cranial wounds were operated on, it would seldom occur.

TREATMENT.—Operations are usually very unsatisfactory. For the general type they are useless, and in Jacksonian epilepsy the symptoms often recur.*

Cases suitable for operation are those with: (a) A definite injury and scar; (b) Localized convulsions; (c) History of less than two years; (d) Absence of family history of epilepsy or insanity.

OPERATION.—After exposing the brain and freeing it from the dura, remove clots, cysts, or massive scars. If no gross exciting cause can be found, the cortical area connected with the muscles which initiate each convulsion should be excised in suitable cases. Place gold-leaf between the brain and the dura.

13. TRAUMATIC INSANITY.—Occurs in about 7 per cent. In the majority the injury merely precipitates a condition to which the patient was disposed. In cases where the injury leads directly to insanity, the lesion is generally over the left pre-frontal or parietal regions.

TREATMENT.—In cases where there was no predisposition to insanity, operation gives good results.

* Cushing, however, gives the following figures: Of 128 cases submitted for treatment, only 59 were operated on. Of these 59, 12 were cured (for periods of 1 to 5 years), 30 were improved, and 17 remained unaffected, of whom 2 died in a status epilepticus. (Keen's *System of Surgery*, vol. iii, p. 251.)

CHAPTER XXVIII.

**DISEASES OF THE CRANIUM, BRAIN,
AND MIDDLE EAR.****DISEASES OF THE SCALP.****Simple Tumours.—**

PAPILLOMA.—Commonly multiple ; may require excision.

FIBROMA.—As a huge pendulous mass forms a pachydermatocele, or else a moderate-sized tumour.

TREAT by excision.

SEBACEOUS CYSTS are very common. Move with the scalp freely over the cranium, and there is no depression in the bone. They may suppurate or fungate, when they form a foul exuberant mass.

TREAT by excision.

DERMOID CYSTS occur near the outer canthus of the eye. They are usually attached to the skull, or buried in a cavity in its surface, or attached to the meninges by a pedicle which goes through the skull.

They should be TREATED by excision, for which the skull may have to be opened.

LIPOMA is lobulated and generally under the aponeurosis, and the scalp moves over it. Usually occurs in the frontal region.

NÆVUS.—See PULSATING TUMOURS, below.

PNEUMATOCELE is an air-containing tumour over the frontal, temporal, or occipital regions. It arises by a communication between the frontal or mastoid air-cells and the cellular tissue of the scalp. Caused by injury or violent sneezing.

TREATED by incision and packing of bone cavity after enlargement of the opening.

Malignant Tumours.—

EPITHELIOMA.—Usually begins at or near the ear. It may, however, start as a papilloma or sebaceous cyst. It has the usual characters, including the implication of lymph-glands.

TREATMENT on usual lines.

RODENT ULCER.—Usually starts from the face and spreads upwards.

SARCOMA.—Is rare as a primary scalp tumour.

Pulsating Tumours.—

NÆVUS.—Especially over the fontanelle, from which it may derive pulsation.

Diseases of the Scalp—Pulsating Tumours, *continued*.

TRAUMATIC ANEURYSM—ARTERIOVENOUS ANEURYSM—ARTERIAL VARIX (temporal)—CIRROID ANEURYSM.—

Most of these occur more commonly in the scalp than elsewhere (see pp. 145, 146, and 152).

Traumatic Swellings of the Scalp.—Hæmatoma—Cephal-hydrocele (see pp. 319, 320).

Inflammatory Swellings of the Scalp.—Abscess, sub-pericranial, subaponeurotic, or superficial (see pp. 319 and 328).

DISEASES OF THE CRANIAL BONES.

Simple Tumours.—

LEONTIASIS OSSEA.—See p. 361.

OSTEOMA.—Cancellous or ivory. Cancellous generally found in relation to frontal sinus or external auditory meatus; may occlude the latter. Ivory generally found in frontoparietal region. They are of slow painless growth, have a broad base, and abrupt edge. Occasionally occur in accessory nasal sinuses.

TREATMENT.—Removal by chisel. Ivory type is very hard, and it is necessary to remove surrounding bone.

ENOSTOSIS.—Found along median anteroposterior line in relation with Pacchionian bodies of superior longitudinal sinus. Rarely these tumours give rise to pressure symptoms.

Malignant Tumours.—

SARCOMA.—May be primary or secondary. A history of injury commonly precedes the disease. Begins as: (1) A periosteal spindle-cell sarcoma; (2) A central myeloid growth which expands the bone; (3) A dural, soft, rapid, round-celled growth, which causes great pain and cerebral compression before breaking through the skull.

All are practically inoperable, except possibly the myeloid growth.

CARCINOMA is always secondary, often to carcinoma of breast, thyroid, or prostate.

Pulsating Tumours of the Skull.—Any of the above forms of sarcoma or carcinoma may pulsate.

Aneurysm by anastomosis may occur in the cranial diploë.

Acute Inflammatory Swellings.—

PERIOSTITIS or OSTEOMYELITIS may complicate any wound, fracture, or contusion. Will lead to: (1) Extracranial abscess; (2) Subcranial abscess; (3) Necrosis of the skull; (4) Pyæmia or septicæmia.

TREATMENT is by free opening.

Chronic Inflammatory Swellings.—

SIMPLE PERIOSTITIS.—From carrying weights on the head or after a blow.

SYPHILITIC PERIOSTITIS.—Hard and soft nodes, the latter being the commoner (*see* p. 242).

TUBERCULOUS DISEASE.—*See* p. 241.

PARROT'S NODES over the frontal and parietal eminences occur in infants with rickets and congenital syphilis. There are other evidences of these diseases.

HYDROCEPHALUS.

PHYSIOLOGY.—The cerebrospinal fluid arises as a secretion or exudation of the ependyma of the choroid plexuses in the ventricles. It escapes from the fourth ventricle through the foramina of Magendie and Luschka into the subarachnoid space. It drains off into the veins, especially into those which enter into the superior longitudinal sinus. Hydrocephalus is caused by an abnormal accumulation of fluid in the ventricles (intraventricular hydrocephalus) or between the brain and the dura (extraventricular hydrocephalus).

VARIETIES.—Hydrocephalus may be produced by: (1) Excess of cerebrospinal fluid; (2) Interference with the circulation of the fluid; (3) Interference with absorption.

1. EXCESS OF CEREBROSPINAL FLUID.—An excess production results from a chronic or acute congestion of the vessels involved in the production of cerebrospinal fluid, e.g., the acute hydrocephalus which may accompany tuberculous meningitis. Engorgement of the choroid plexus of the lateral ventricle resulting from thrombosis of the efferent veins of Galen gives an excess production.
2. INTERFERENCE WITH CIRCULATION OF CEREBROSPINAL FLUID.—Is either (a) Ventricular, or (b) Extraventricular.
 - a. *Ventricular*.—Caused by adhesions in or over the roof of the 4th ventricle from a birth hæmorrhage, transient mild meningitis in infants, syphilitic meningitis. It may also be due to pressure of a tumour on the foramen of Monro, the iter, or the 4th ventricle.
 - b. *Extraventricular*.—Caused by inflammatory changes over the cerebral convolutions, and blocking of the apertures at the tentorium cerebelli by inflammatory exudates, tumours, and hæmorrhage.
3. INTERFERENCE WITH ABSORPTION OF CEREBROSPINAL FLUID.—Absorption takes place through the arachnoid villi which project into the venous sinuses. Chronic inflammatory changes in relation to these will seriously affect absorption and discharge of the cerebrospinal fluid into the venous blood-stream.

Hydrocephalus, continued.

DIAGNOSIS.—Inquire for syphilis, birth injuries, transient meningitis, and such symptoms as may point to the presence of tumour.

SIGNS.—The cranial cavity is increased, but the bones are much thinned, and in infancy the fontanelles and sutures gape.

ETIOLOGY.—Usually in a child, sometimes associated with maternal hydramnios. Several members of the family may have it. In some cases there is a relation to syphilis. The ventricles of the brain are greatly distended, and the cerebral substance is atrophied. In extreme cases fluctuation and bony crackling may be felt. The forehead becomes protuberant, and the eyes are pushed forwards. The face is disproportionately small, the ears and eyes being overhung by the bulging cranium. The veins of the scalp and eyelids are engorged.

SYMPTOMS.—Child can hardly raise its head. It hardly ever cries, because crying increases the intracranial pressure. Vomiting is common, and there is great wasting. Blindness. Usually succumbs to an intercurrent disease. If survival occurs, it is associated with mental deficiency and physical weakness.

AIDS TO DIAGNOSIS AS TO TYPE.—

1. *Phenolsulphonephthalein Test.*—Inject phenolsulphonephthalein into 3rd ventricle. Later, lumbar puncture, and if by addition of an alkali the phthalein reaction is produced, then the communication between intra- and extra-ventricular streams is complete—i.e., hydrocephalus is extraventricular.
2. *Ventriculography.*—Pass a needle through the anterior fontanelle into the lateral ventricle, and after removal of some cerebrospinal fluid inject its equivalent of air or oxygen. The head is then screened or a series of X-ray photographs taken. The position of the head is changed so as to pass the gas from ventricle to ventricle.

TREATMENT.—Operation only to be performed in extreme cases, and where general treatment gives no hope of relief.

If condition is syphilitic in origin, give antisyphilitic treatment.

Where tumour is diagnosed, operate if removal is possible.

Where meningitis has caused extraventricular hydrocephalus, cure is seldom possible, but spontaneous arrest may take place. Where the condition is progressive, the following have given relief. Ligation of the common carotid arteries in a child; first the right and three weeks later the left. Removal of the choroid plexus from the lateral ventricle, an extremely dangerous operation. When dealing with an intra-ventricular hydrocephalus, with obstruction in the roof of the 4th ventricle, operative treatment has been more successful. Approach is made to the 4th ventricle by the suboccipital route, and an opening made in the roof of the ventricle through

which a catheter may be passed, and communication between the intra- and extra-ventricular streams re-established. Tapping the lateral ventricle and leaving a strand of silk ligatures from the ventricle to the subarachnoid space has been tried. Cushing has drained the lumbar theca into the peritoneal cavity by a cannula passed through the 5th lumbar vertebra.

External Hydrocephalus.—

This is a very rare condition. The fluid lies between the brain and dura. The brain is small and atrophic. Always associated with idiocy.

TUMOURS CAUSED BY PROTRUSION OF THE BRAIN OR ITS MEMBRANES THROUGH THE SKULL.

Congenital.—

MENINGOCELE.—A protrusion of the meninges containing fluid.

ENCEPHALOCELE—A protrusion of brain substance through a congenital defect in the skull.

HYDRENCERPHALOCELE.—A combination of the above, or a brain protrusion in which is a cavity communicating with the lateral ventricle.

All these are large swellings which pulsate with all respiratory movements. Those containing brain also pulsate with heart movements. They usually spring from the root of the nose, the occiput, or the region of any of the sutures. Round their broad base can be felt the bony margin of skull defect. They are partly reducible, the reduction being accompanied by convulsions. The skin over them is often thin and nævoid.

TREATMENT is usually impossible. In pure meningocele excision may be possible. Never attempt operative procedures where the condition accompanies a progressive hydrocephalus.

Acquired.—

1. **SARCOMA OF THE BRAIN OR MENINGES.**

2. **HERNIA CEREBRI.**—Occurs after: (a) Ineffectual operations for cerebral tumours; (b) Injuries or operations on the skull under septic conditions.

It is CAUSED by the increased intracranial pressure. The mass consists chiefly of œdematous granulations, but true brain substance may also protrude.

TREATMENT is chiefly: (a) Preventive, in making free outlet for septic discharges when operating for fracture of the skull; (b) Pressure must be used with great care; (c) Painting with absolute alcohol or collodion; (d) Covering with a protective shield; (e) Removal is justifiable only when the hernia is due to a septic process which has come to an end.

INTRACRANIAL TUMOURS.

Varieties.—Arise from: (1) Brain tissue; (2) Meninges; (3) Skull and dura.

1. FROM BRAIN TISSUE.—GLIOMA. A sarcoma consisting chiefly of neuroglia. A soft infiltrating growth, very vascular, and often cystic. Very liable to hæmorrhage into the cysts. Arises in cerebral cortex nerve roots, retina, and brain stem. Seldom suitable for removal.
2. FROM MENINGES.—MENINGIOMA. Consists of whorls of endothelial cells. Have been termed endotheliomata psammomata, and, when highly cellular, sarcomata. Two types are described—circumscribed, and diffuse or spreading. They do not infiltrate brain tissue, but may permeate the adjacent skull. They form no metastases, and are favourable for removal.
3. FROM SKULL AND DURA.—SARCOMA. Usually cortical and slow growing. Does not as a rule infiltrate brain tissue. Has a well-defined margin. May be removed surgically, and a long period follow with no recurrence.

Other intracranial tumours are: (4) EPENDYMAL TUMOURS from the walls of the ventricles; (5) NEUROFIBROMA from the acoustic nerve; (6) ARACHNOID CYSTS—arise after trauma from an absorption of blood-clot; (7) SIMPLE CYSTS—of very doubtful origin; (8) SECONDARY CARCINOMATA; (9) TUBERCULOOMA—occurs especially in children, often multiple and often encapsuled; (10) SYPHILOMA—gummata most frequently grow from the basal meninges.

Symptoms.—

HEADACHE in a fixed locality, subject to great exacerbations and becoming steadily worse. But little amenable to therapeutic measures.

VOMITING.—Constantly repeated without nausea or relation to food. Particularly severe in basic or subtentorial tumours. Both the headache and vomiting are often worse in the morning or after movement.

OPTIC NEURITIS.—Beginning as a congestion and then as a 'choked disc,' and ending in atrophy. Most constant in basic growths. The eye on the side of the tumour is affected first and to the most marked degree.

GIDDINESS, EPILEPSY, LOSS OF MEMORY, and other mental changes occur with different frequency, according to the regions affected.

MENTAL STUPOR, ending in COMA.

FOCAL SYMPTOMS are produced only when certain areas of the brain are affected (*see* p. 348). When a motor area is affected, localized convulsions followed by temporary local paralysis are the rule. The convulsions and paralysis tend to become more widely spread and more permanent.

IN THE CEREBELLO-PONTINE tumours there are paralysis of the third, sixth, and seventh nerves, with trigeminal anæsthesia or hyperæsthesia, and tinnitus succeeded by deafness, from involvement of the fifth and eighth.

Duration of Life is very variable, the average being about three years. Death may occur suddenly from hæmorrhage. Cases of cysts or innocent growths may live for a lifetime in an asylum.

Treatment.—

MEDICINAL TREATMENT is useless, except in the case of gummata, where large doses of iodides should be given.

OPERATIVE TREATMENT: REMOVAL.—

Morphia ($\frac{1}{2}$ gr.) is administered beforehand to diminish the shock. The patient has the head and trunk raised. The blood-pressure should be observed at intervals throughout the operation. If it falls much after exposure of the dura it is best to defer removal of the tumour to a subsequent stage.

HÆMORRHAGE is controlled thus:—

1. *From Scalp Vessels.*—Scalp tourniquet. Hæmostatic clamps or suture.
2. *From Bone.*—Horsley's wax.
3. *From Dura.*—Irrigation with hot water (115–120° F.). Elevation of head.

SKULL OPENING.—May be made in one of two ways:—

1. By first turning down a flap containing all the soft parts, and then removing the bone by trephine, gouge, and forceps. Suitable for small openings and those in the temporal or occipital regions.
2. Turning down an osteoplastic flap containing scalp and cranium, cutting through the bone by a Gigli's saw or surgical engine. The bone at the base of the flap must be broken. This method is the best when making large openings at the vertex, or frontal or parietal regions.

On exposure of the dura mater, the latter bulges into the wound, and cerebral pulsation is ill-marked if the intracranial pressure is much increased. The dura is opened crucially or by a flap, and the brain explored and any mass removed. Cysts and tuberculous foci can usually be shelled out with little hæmorrhage, but other tumours are ill-defined and require the brain substance to be cut. All vessels of the pia mater over the area of the brain to be incised should be divided between ligatures.

The two-stage operation, in which the skull is opened one time and the brain explored subsequently, has the advantage of lessening shock, but the disadvantages of increasing the dangers of sepsis and the bleeding from granulations. An anæsthetic is not always necessary for the second stage of the operation, or need only be given for the final suturing.

Intracranial Tumours—Treatment, continued.

The bone can be replaced if the fragment is large, and the wound drained for twenty-four hours.

If the operation is unsuccessful or incomplete, a hernia cerebri will probably form.

PALLIATIVE OPERATION.—In irremovable growths, a decompressive operation will prolong life and prevent blindness and relieve the headache and vomiting.

FOR CEREBRAL TUMOURS a subtemporal operation is best, with a free bone removal.

FOR CEREBELLAR TUMOURS a suboccipital operation through a T-shaped incision, the muscles being reflected, and the bone freely removed down to and including the margin of the foramen magnum. This is also the best way to remove cerebellar tumours, because it admits of such free exposure of the cerebellum, and the unaffected lobe can be pushed to one side whilst the other is being dealt with.

Pituitary Tumours.—Tumours of the pituitary gland differ from other intracranial tumours, in their relation to the general processes of body growth influenced by the pituitary internal secretion, and in their specially close effect upon vision owing to their proximity to the optic nerves.

FUNCTIONS OF PITUITARY.—Exercises controlling influence on carbohydrate metabolism and skeletal and sexual development, and regulates capillary tone.

HYPERPITUITARISM.—Produces gigantism if occurring in the young and acromegaly in the adult. X rays may show expansion and irregularity in the sella turcica. Sexual hyperactivity. Polyuria, glycosuria. Melancholia.

HYPOPITUITARISM.—Produces stunted skeletal growth. Sexual functions undeveloped. Two common clinical types:—

1. *Dystrophia Adiposogenitalis* or *Fr hlich's Syndrome*.—Stunted, stupid, and fat children. Genitals undeveloped.
2. *Lorain Type* or *Ateleiosis*.—Stunted and sexually undeveloped, but mentally normal.

PATHOLOGY OF PITUITARY TUMOURS.—

1. **PITUITARY TUMOURS PROPER.**—(a) Eosinophil adenomata, producing hyperpituitarism; (b) Chromophobe adenomata, producing hypopituitarism.
2. **EXTRA-PITUITARY TUMOURS.**—Cysts and meningiomas of Rathke's pouch.

SYMPTOMS.—Two classes: (1) Those due to mechanical causes (pressure effects); (2) Those due to disordered function.

1. MECHANICAL SYMPTOMS.—

- a. Headache of bursting type.
- b. Bitemporal hemianopia.
- c. Third-nerve palsy.

- d. Primary optic atrophy and blindness (cf. ordinary cerebral tumours, which cause papilloedema and secondary optic atrophy).
 - e. Absorption of sella.
 - f. Somnambulism and polyuria from pressure on floor of third ventricle.
 - g. Paræsthesia of face (5th nerve).
2. SYMPTOMS DUE TO DISORDERED FUNCTION.—
- a. Hyperpituitarism from eosinophil adenomata.
 - b. Hypopituitarism from chromophobe adenomata and the extra-pituitary tumours.

OPERATIVE TREATMENT.—

INDICATIONS.—Severe headache and progressive blindness.

METHODS.—

1. *Trans-sphenoidal Sellar Decompression*.—Submucous resection of nasal septum exposing under surface of body of sphenoid. The sphenoidal cells are broken down and the gland exposed.
2. *Frontal Route* (Frazier).—An osteoplastic flap is turned outwards from the frontal region, and the diaphragma sellæ is reached by elevating the frontal lobe.

CEREBRAL LOCALIZATION.

The localization of function in different parts of the brain is shown by the disturbance which follows injury and disease. Such disturbance may be either an abnormal activity produced by an irritative lesion, or a diminished activity caused by a destructive lesion. Thus, in the case of motor centres, there may be convulsions or paralysis of muscles; and, with affections of sensory centres, abnormal sensations (e.g., tinnitus, flashes of light, tingling, or a sensory aura), or anæsthesia. The nature of the localizing or focal symptoms depends on the situation of the local lesion more than upon its nature, so that quite different causes may produce the same focal symptoms. Further, there are certain general symptoms associated with intracranial disease which help to determine its nature and extent.

Local Lesions which may cause focal symptoms are: (1) Punctured wounds; (2) Depressed fractures; (3) Foreign bodies; (4) Meningeal hæmorrhage or inflammation; (5) Scar tissue associated with the cerebral cortex; (6) Abscess; (7) Tumour.

General Symptoms associated with intracranial disease and usually accompanying cerebral compression are as follows:—

HEADACHE of cerebral origin. Severe, worse on movement, and usually fixed to a special locality of the head. It is probably caused by pressure on the dura mater, and is roughly proportionate to (a) the intracranial tension, and (b) the direct implication of the meninges by disease. It must be distinguished from the following groups:—

Toxic.—Associated with any condition of fever or toxæmia.

Intracranial Disease—General Symptoms—Headache, *continued*.

RENAL.—This is probably a cerebral condition caused by œdema of the brain. The conditions of the heart and urine give clues to its nature.

REFLEX.—From disease of the sense organs. Disease of the nasal sinuses, glaucoma and iritis, otitis, and dental caries are examples of these.

VOMITING.—Usually sudden, projectile, and unaccompanied by nausea. It is worse after movement.

VERTIGO.—Especially associated with lesions of the eighth nerve, the mid-brain, and the cerebellum.

OPTIC NEURITIS.—Occurs in two stages.

CHOKED DISC is the congestion of the retina and œdema of the optic papilla resulting from increased intracranial pressure.

It is usually bilateral, but the eye on the side of the lesion may be affected earlier or to a higher degree than the opposite.

NEURITIS AND ATROPHY.—True neuritis may be caused by long-continued pressure or congestion, or atrophy may be the primary change. In the latter case a lesion at the base of the brain is indicated.

BLINDNESS may not be present, even with a high degree of choked disc or neuritis.

Localization of Function in the Cerebral Cortex.—Each cerebral hemisphere is functionally related to the opposite side of the head and body. Centres for voluntary movements are more sharply marked than those for sensation.

THE MOTOR CENTRES (*Fig. 105*) lie in the pre-central or ascending frontal gyrus immediately in front of the fissure of Rolando. They occupy the following position from above downwards:—

Foot	} upper third	Shoulder	} middle third	Neck	} lower third
Knee		Elbow		Nose	
Hip		Wrist		Lips	
Trunk		Fingers & thumb		Jaw	

The centres for the trunk and for the neck are opposite the genua or bends taken by the Rolandic fissure, and serve to separate the centres for the leg, arm, and face. The centres for the tongue, palate, larynx, and vocal cords lie close together above the front of the main limb of the Sylvian fissure.

THE MOTOR SPEECH CENTRE is in Broca's convolution on the left side (this applies to right-handed persons; in left-handed persons it is in the right hemisphere). This lies in the angle between the vertical and posterior horizontal limbs of the Sylvian fissure, and is the posterior part of the third frontal convolution.

THE MOTOR WRITING CENTRE is at the posterior part of the second left frontal convolution, just in front of the motor centre for the hand.

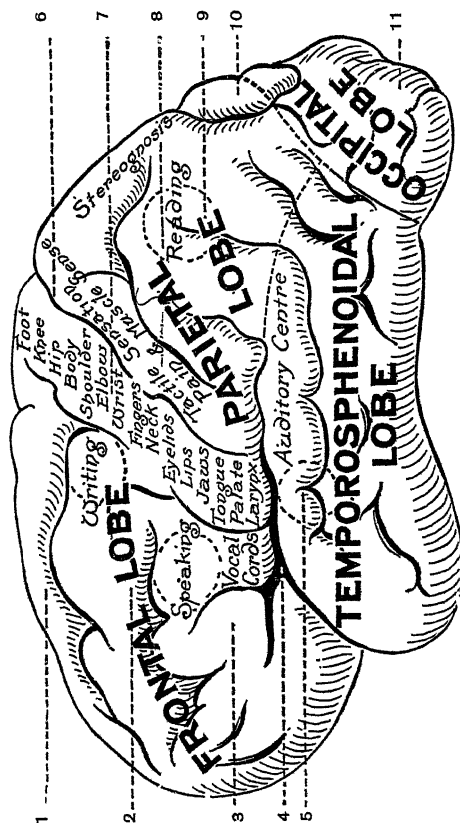


Fig. 103.—Localization of function in cerebral cortex. 1, Upper frontal gyrus; 2, Middle frontal; 3, Inferior frontal; 4, Fissure of Sylvius; 5, Word hearing; 6, Fissure of Rolando; 7, Precentral gyrus; 8, Postcentral gyrus; 9, Angular gyrus; 10, Parieto-occipital fissure; 11, Occipital lobe. Note.—The leg centres are rather larger than those for the arm, but in this lateral view are necessarily foreshortened.

Localization of Function in the Cerebral Cortex, continued.**SENSORY CENTRES.—**

COMMON TACTILE SENSATION is localized in the postcentral or ascending parietal gyrus just behind the Rolandic fissure.

The sensory centre for each part of the body is just behind the corresponding motor centre.

CENTRES FOR PAIN AND MUSCULAR SENSATION are not represented in the cortex. Probably in the optic thalamus.

STEREOGNOSTIC SENSATION is localized in the upper parts of the parietal lobe. Stereognosis is the power of recognizing the shape and size of objects by touch.

VISUAL CENTRE is in the occipital lobe, with which the angular gyrus is associated. The left half of each retina is associated with the left occipital lobe, and vice versa.

READING CENTRE is in the left angular (parietal) gyrus.

AUDITORY CENTRE is in the superior temporal gyrus.

THE SPEECH-HEARING CENTRE corresponds to the left auditory centre.

OLFACTORY AND TASTE CENTRES probably lie near tip of the temporal lobe at its mesial aspect, i.e., the uncinate gyrus.

The Symptoms arising from Local Brain Lesions.—

MOTOR.—Convulsions or paralysis.

CORTICAL LESIONS usually cause monoplegia associated with convulsions.

CAPSULAR LESIONS cause hemiplegia without convulsions.

PONTINE LESIONS cause 'crossed paralysis,' i.e., same side of the face, opposite side of the body.

BIRTH PALSIES AND SPINAL PALSIES are usually spastic diplegia or paraplegia.

SPASTICITY associated with paralysis indicates a lesion of conducting tract and not motor centre.

CONVULSION associated with paralysis indicates a lesion of the motor centre.

SENSORY.—

PARALYTIC.—Anæsthesia of various kinds. It is usually very fleeting. It is most marked at the extremities farthest removed from the brain, and gradually shades off into areas of normal sensation.

IRRITATIVE.—Some abnormal, often painful, sensation either special or general. Such are the auræ which precede epileptic fits.

The Regions of the Brain associated with Focal Symptoms.—**ROLANDIC AREA.—**

IRRITATIVE LESIONS cause Jacksonian convulsions, which begin in certain muscles and spread in the order of the arrangement of the motor centres to other muscles. Consciousness may not be lost until half the body is affected.

TUMOURS cause convulsions followed by paralysis.

INJURY causes paralysis without convulsions.

INFLAMMATORY LESIONS cause convulsions without paralysis.

SENSORY SYMPTOMS, as stated above, are very transient with cortical injuries. More permanent anæsthesia is produced by subcortical lesions (e.g., of the internal capsule), and is always associated with some paralysis.

FRONTAL LOBE.—(Clinically this term excludes the ascending frontal gyrus, which constitutes the motor area.)

THE FRONT AND UPPER PARTS OF THE FRONTAL LOBE (prefrontal area) are unexcitable, and extensive lesions may be quite latent. Or they may cause insidious changes of character, loss of memory, apathy, loss of power of inhibition. Most marked in left prefrontal lesions.

THE POSTFRONTAL REGION below contains the motor speech centre on the left side. Lesions of this cause aphasia.

PARIETAL LOBE.—(Apart from the postcentral Rolandic gyrus.)

LESIONS OF THE ANGULAR GYRUS on the left side cause word blindness.

OF THE UPPER PARIETAL LOBE.—Loss of stereognostic sense, i.e., the power of recognizing objects by tactile sense.

OCCIPITAL LOBE.—Destructive lesions cause homonymous hemianopsia (i.e., blindness of that half of the retina of both eyes which is on the same side as the lesion. This is permanent if the angular gyrus is destroyed simultaneously. The pupil reflex is not lost. WORD BLINDNESS results from lesions of the left angular gyrus.

TEMPORAL LOBE.—WORD DEAFNESS results from lesions of the superior left temporal gyrus.

OLFACTORY AND GUSTATORY symptoms are caused by lesions of the uncinate gyrus.

CAUDATE AND LENTICULAR NUCLEI AND INTERNAL CAPSULE.—Hemiplegia, with some sensory loss.

OPTIC THALAMUS.—Contralateral athetosis and chorea, paræsthesia, and hemianopsia.

CRUS CEREBRI.—Hemiplegia, with oculomotor paralysis and loss of pupil reflex of the eye on the same side as the lesion.

CORPORA QUADRIGEMINA.—Ophthalmoplegia, reeling gait, vertigo, tendency to fall backwards.

PONS.—Paralysis of the face on the side of the lesion and of the limbs on the opposite side.

CEREBELLUM.—Instability of station and locomotion, with coarse ataxia accompanying voluntary movements.

MIDDLE LOBE.—The symptoms are bilateral. There is a tendency to fall backwards or forwards.

Regions of Cerebellum associated with Focal Symptoms, *continued*.

LATERAL LOBE.—Weakness of the movements of the arm on the same side. The head is bent to the side of the lesion and the face turned away from it. In walking there is a tendency to rotatory deviation, turning or falling towards the affected side. There may be conjugate deviation of the eyes and nystagmus towards the side of the lesion. (The eye movements are variable in cerebellar disease. A lateral excitation causes deviation of the eyes to the same side. A lateral paralytic lesion may cause deviation of the eyes to the opposite side. But often the lesion causes no eye symptoms.)

OTITIS MEDIA.

Varieties.—Catarrhal, acute purulent, and chronic purulent.

Causes.—Pharyngitis—Pharyngeal catarrh (spreads up the Eustachian tubes)—Tonsillitis—Scarlet fever and other fevers—Diphtheria—Adenoids.

Symptoms.—Great pain on onset, relieved when the drum perforates. Temperature raised to 100°–105° F.

Deafness—Usually partial only—Tuning-fork can be well heard if applied to the bones—Tuning-fork can be better heard in the affected ear when held to the vertex.

Tinnitus.

Purulent discharge from the meatus: only after the drum has perforated.

Signs.—

BEFORE PERFORATION OF THE DRUM.—Drum is first red, and then has lost its lustre, and is abnormally bulged outwards. It does not move on swallowing or on politizerization.

AFTER PERFORATION.—On cleaning away pus from meatus, tympanum is seen to be perforated. In old cases the tympanum is destroyed, and bare bone or the ossicles may be seen or felt. On politizerization air escapes from the meatus if the Eustachian tube is patent.

Treatment of uncomplicated cases.—

CATARRHAL OTITIS.—Usually associated with pharyngeal catarrh or adenoids. Treat the pharyngeal catarrh with astringent gargles or sprays, e.g., protargol gr. iv ad ʒj. Remove adenoids. Syringe meatus with warm boracic lotion. For acute pain of 'earache', leech in front of the tragus, and hot sand-bags.

ACUTE PURULENT OTITIS.—

BEFORE PERFORATION, or if the perforation is minute, artificial leeches in front of and behind the ear. Free incision of the tympanic membrane from the centre downwards, followed by boracic irrigation. General treatment of the febrile condition.

AFTER PERFORATION, when free discharge has taken place, douching meatus with 1–2000 biniodide of mercury. Dry meatus and instil boracic powder.

COMPLICATIONS OF PURULENT OTITIS MEDIA.

Most commonly seen with the chronic cases. (*Fig. 106.*)

EXTRACRANIAL.—Eczema of the meatus. Boils and deep inflammation of the meatus. Suppurative arthritis of temporomaxillary joint.

CRANIAL.—Ankylosis or necrosis of the ossicles. Necrosis of parts of the temporal bone. Polypi (granulations) in place of the destroyed drum. Facial paralysis from pressure on the seventh nerve. Mastoiditis. Labyrinthitis.

INTRACRANIAL COMPLICATIONS.—Subcranial abscess—Meningitis—Thrombosis of the lateral sinus—Cerebral abscess in temporosphenoidal lobe or cerebellum.

Acute Mastoiditis.—

SYMPTOMS.—Intense pain of a constant character. Tenderness behind the ear over the mastoid process. Redness and cedema over the mastoid. Auricle is displaced forwards, outwards, and downwards. Eventually a fluctuating abscess forms behind the ear. General febrile symptoms: Temperature 102° – 104° F.

Rigor may occur (but repeated rigors point to sinus thrombosis).

TREATMENT.—

IN EARLY STAGE before the diagnosis is certain.—Leeches in front and behind the ear. Hot fomentations.

WHEN THE DIAGNOSIS IS CLEAR.—Open and clear out the mastoid antrum. Incision curved behind the auricle. Gouge or drill over a point where the tangents above and behind the meatus cross. Antrum is reached a quarter to half an inch below bony surface. Remove all the bone between the antrum and the external meatus, protecting the seventh nerve by a probe passed from antrum to attic. Incise the cartilaginous meatus posteriorly. Sew back the two flaps to the pinna. Drain the whole cavity through the meatus.

Intracranial Complications of Otitis Media.—

DIAGNOSIS.—In all the following occur: Marked cerebral symptoms. Acute headache. Coma or delirium. Purulent discharge from the ear becomes scanty or ceases.

SINUS THROMBOSIS.—Repeated severe rigors. Temperature rises to 103° – 105° F., but falls between the rigors. Patient is blue and collapsed. Tenderness or swelling over the internal jugular vein.

MENINGITIS.—Initial rigor, with continuous high temperature. Retraction of the head. Optic neuritis. Intolerance of light and sound. Rapidly developing coma.

SUBCRANIAL ABSCESS (pus between the dura and the petrous bone).—Severe headache. Gradual cerebral compression. Irregular fever. Absence of the signs characteristic of thrombosis, meningitis, or abscess.

Intracranial Complications of Otitis Media, *continued*.

CEREBRAL ABSCESS.—Temperature is normal or subnormal. Constant headache, merging into coma. Slow pulse. Slow respiration—Cheyne-Stokes later. Optic neuritis and paralysis of pupil on affected side.

CEREBELLAR ABSCESS.—In addition to the above, may be nystagmus. Giddiness, with tendency to fall to affected side.

Treatment of Intracranial Complications of Otitis.—First expose and ligature the internal jugular vein in the neck (if sinus thrombosis is clear). Perform radical mastoid operation and follow track to abscess, removing bone upwards and forwards for temporosphenoidal abscess, or backwards for sinus thrombosis and cerebellar abscess.

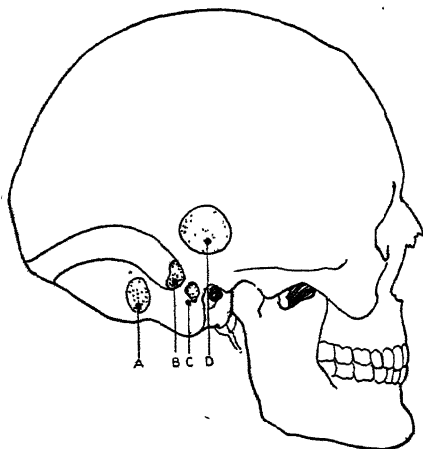


Fig. 106.—Complications of middle-ear disease. A, Cerebellar abscess; B, Lateral sinus thrombosis; C, Suppuration in mastoid antrum; D, Temporosphenoidal abscess.

CHAPTER XXIX.

DISEASES OF THE LIPS AND JAWS.

THE LIPS.

Macrocheilia or Thick Lips.—

1. CONGENITAL.—Lymphangiectasis—Clear lymph-vesicles can be seen on the surface—Generally affects the lower lip.
TREAT by excision of a wedge-shaped piece.
2. TUBERCULOUS.—In children and young adults—Generally the upper lip—May be associated with tuberculous disease of the nose—Fibrous and œdematous thickening round fissures.
3. SYPHILITIC.—Fibrous hypertrophy in tertiary disease.

Ulcers of the Lips.—

1. SIMPLE.—Cracks and fissures result from cold in those with bad circulation. Chilblains and ulcerated chilblains arise in the same way.
2. HERPES.—Generally unilateral. Associated with catarrh or pneumonia. Crop of vesicles become pustular and then break.
3. TUBERCULOUS.—Either chronic indurated fissures causing macrocheilia; or definite lupus, with clear tubercles and destructive ulceration.
4. SYPHILITIC.—
PRIMARY CHANCRE.—Usually the upper lip. Caused by kissing person with secondary lesions of mouth, or using pipe or cup contaminated by such a patient. Flat ulcer on an infiltrated base. Skin more involved than the mucous membrane. Glands enlarged and massed together under the jaw (not so discrete as in genital chancre).
SECONDARY.—Mucous tubercles and shallow, painful ulcers.
TERTIARY.—Deep serpiginous ulceration destroying the lip—glands not enlarged. Or general fibrous hypertrophy (macrocheilia).
INHERITED.—Cracks and fissured ulcers radiating from the angles of the mouth. Leave permanent scars and contraction.
5. MALIGNANT.—
EPITHELIOMA.—95 per cent are in men—generally clay-pipe smokers. Much commoner in lower than upper lip. Begins as crack, ulcer, or wart. Causes an ulcer or warty growth—indurated and everted margin, and indurated base. Submental and submaxillary glands become hard and enlarged comparatively late, i.e., after three to nine months.

Epithelioma of the Lips, *continued*.

Much slower in its development than epithelioma of the tongue or fauces.

Diagnosis should always be made certain in doubtful cases by removal and microscopical examination.

TREATMENT.—Remove with at least half an inch margin.

Dissect out submental and submaxillary glands from both sides, whether these are felt enlarged or not.

DEATH occurs from septic ulceration of the glands in the neck.

Tumours of the Lips.—Besides the ulcers given above, the following occur :—

WARTS.—Remove for fear of malignant growth, and examine with microscope.

NÆVI.—Dissect out or destroy by electrolysis.

CYSTS.—Caused by retention in the labial mucous glands. Small round fluid swellings containing glairy mucous fluid. Dissect out.

Hare-Lip.—Congenital cleft in upper lip. Usually single and unilateral, left-sided, and in boys. Often double and bilateral. In simple cases the soft parts only are affected. In others the alveolus of the jaw or the palate may be cleft. When complete it extends into one nostril. Commoner on left side.

In all cases the nose is broad and flat. In double cases the bone between the clefts projects forward like a proboscis. Often associated with other deformities, e.g., talipes, etc. If the alveolus is involved, the cleft generally goes between the central and lateral incisor.

CAUSED by a failure of union of the internal nasal process with the maxillary process superficially, and the external nasal process more deeply.

EFFECTS.—Interference with suckling, and with speech. Deformity, which gets worse with age.

TREATMENT.—Operate at six weeks to three months.

FOR SINGLE HARE-LIP.—Separate central parts of the lip from bone beneath. Pare the edges. Leave single or double flap of red margin, so that when sewn together there will be an allowance for contraction. Two deep stitches to take off tension. Many fine horsehair stitches to edges. Plaster strapping across the face to relieve tension. Put arms into splints. Feed by spoon, or better, nasal tube. Allow to suck at end of one week.

FOR DOUBLE HARE-LIP.—

Treatment of os incisivum when projecting forwards :
Refresh the anterior end of the nasal septum ; push back the proboscis and sew to the septum.

Treatment of cleft: Separate lip from the underlying bones. Pare both edges of both clefts. Sew outer margins of both clefts together below central part, which takes no part in margin. Leave a flap from red margin of each outer margin of each cleft.

CLEFT PALATE.

A congenital defect in the union of the two halves of the palate.

Degrees.—(1) Bifid uvula; (2) Cleft soft palate; (3) Soft and hard palate cleft as far forward as the anterior palatine foramina; (4) Including the alveolar border of the maxilla and lip, i.e., combined with a double hare-lip.

Varieties.—

1. Mesial—the cleft is in the mid line, and the nasal septum is above and ununited to any part of the cleft.
2. Bilateral—the nasal septum grows down and divides the cleft into two.
3. Unilateral—the nasal septum unites with one side of the cleft. The cleft is usually on the left side.

Development of Alveolar Cleft Palate.—In man the premaxillæ are commonly rudimentary pieces of bone which are attached to the apex of the vomer. They take no part in the formation of the face, and bear no teeth. The maxillæ, on the other hand, send two processes inwards, which surround the premaxillæ, excluding the latter from the face; these are:—

1. The incisor process in front, which meets its fellow and bears the incisor teeth.
2. The palatine process behind, which forms the hard palate.

Between these two the anterior palatine foramen is left, in the inner wall of which the rudimentary premaxillæ remain.

In simple cleft palate, the palatine processes of the maxillæ are defective.

In alveolar cleft palate, the incisor processes of the maxillæ are defective, and the premaxillæ grow forward into the face, as is the rule in lower animals. The alveolar cleft is then the space between the abnormal premaxilla and the undeveloped incisor process of the maxilla.

In the most extreme cases, the premaxillæ bear all four incisor teeth, and there is a cleft on each side of them separating them from the maxillæ bearing the canines.

In less-developed cases the premaxillæ bear only one incisor, and the incisive process of the maxilla bears the other, and the cleft comes between the central and lateral incisors,

Cleft Palate, *continued*.

Appearances.—Through the cleft are seen the nasal septum and the turbinate bone. The width is greater in the more complete cases. The slope of the sides varies, being upwardly directed rather than horizontal.

Effects.—Sucking is impossible, and the infant must be spoon-fed. Defective speech is caused by the impossibility of closing the oral from the nasal cavity. Thus explosive sounds, e.g., the letters *T, D, P, B, F, V*, become *M* or *N*, and gutturals, e.g., *K* and *G*, become *H*.

Treatment.—

OPERATIVE.—Suitable for all cases up to twenty years.

OBTURATOR: A dental plate is fitted to fill up the gap; but this never benefits the speech much, because it cannot act like a normal soft palate.

LANGENBECK'S, SMITH'S, OR THE LATE OPERATION.—

Performed at or about the **THIRD YEAR**, when the soft parts have attained some thickness and firmness. The edges of the cleft are pared, and the mucoperiosteum lifted off the bone from the cleft outwards. The soft palate is completely cut from the hard palate bone at their junction, the soft palate remaining connected with the mucoperiosteal flaps. Any bands passing from the pharynx to the upper surface of the palate are snipped through. Lateral incisions are made through half the length of the soft palate up to the second premolar tooth to relieve tension. The two halves are sewn together; silver wire is used for the mucoperiosteum of hard palate, horsehair for soft (*Figs. 107, 108*).

It is essential that the soft palate shall come together without any tension.

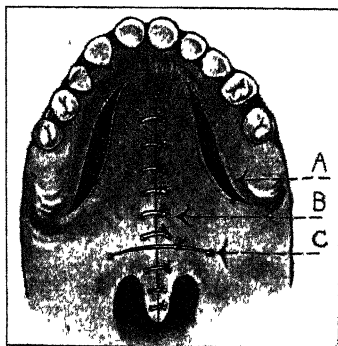
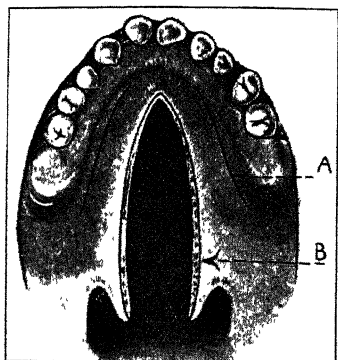
Gaps often occur in the hard palate, but are easily remedied by subsequent operations; to get a sound and mobile soft palate is the chief object aimed at.

Long and careful speech education is required to correct the faulty articulation.

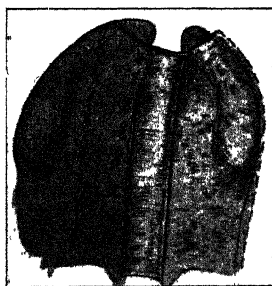
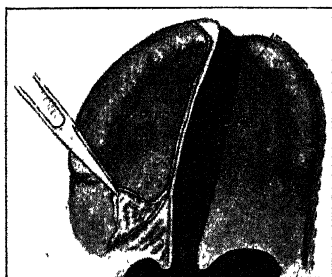
ADVANTAGES OF THE LATE OPERATION.—(1) The danger to life is negligible; (2) The parts are firmer and thicker than in infancy; (3) The cleft naturally diminishes within the first three years of life; (4) The soft palate, by its separation from the hard, has the best chance of union and subsequent mobility.

DISADVANTAGES OF THE LATE OPERATION.—(1) Parents are seldom satisfied to wait two or three years; (2) Defective speech is acquired before the time of operation; (3) Gaps often recur over the hard palate which require subsequent operations.

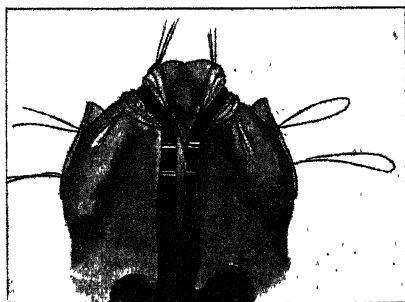
LANE'S, DAVIES-COLLEY'S, THE FLAP, OR EARLY OPERATION.—Performed at the **THIRD MONTH**, i.e., before any teeth have erupted. A mucoperiosteal flap is cut from one side, the outer free margin of which lies outside the gums. This is turned



Figs. 107, 108.—Langenbeck's operation of direct suture for cleft palate. A, Lateral incisions to relieve tension; B, Median cleft, refreshed and sutured; C, Tension suture.



Figs. 109, 110.—Lane's or Davies-Colley's flap operation for cleft palate.



Figs. 111, 112.—Brophy's operation for cleft palate in a case of double hare-lip.

Cleft Palate—Lane's or Davis-Colley's Operation, *continued*.

over, the attached margin at the cleft acting as a hinge. The muco-periosteum is raised from the opposite side as a flap, having its hinge outside over the gums. The first flap is turned over to the opposite side with the raw surface downwards, and stitched between the opposite flap and the bone. The soft palate is completed by a separate mucous membrane flap (*Figs. 109, 110*).

CLAIMS OF THE EARLY OPERATION.—(1) That the defect is closed long before the child has learned to speak badly; (2) That a double layer of tissue is used to close the chief part of the gap; (3) That there is no tension on the flaps thus made; (4) That there is no interference with the muscles and nerves of the soft palate.

DRAWBACKS TO THE EARLY OPERATION.—(1) The risk to life from asphyxia, hæmorrhage, and sepsis, when done so early; (2) The fragile nature of the tissues; (3) The smallness of the available operative space; (4) The large raw surfaces left in the mouth to heal by granulation; (5) The soft palate, not being separated from the hard, does not come together well, and is therefore likely to fail in union.

BROPHY'S OPERATION.—For cases of complete cleft in early infancy.

PRELIMINARY CONSIDERATIONS.—In all except very rare cases, there is at birth no deficiency of tissue, but merely a divarication; the upper jaw is wider than normal by the width of the cleft. This is possibly caused by the pressure of the tongue keeping the halves of the maxillæ from junction. As the child becomes older, the abnormal parts, especially the soft palate, fail to grow at the same rate as the rest of the tissues, and therefore they become proportionately too small.

OPERATION.—Must be done before the child is 6 months old—preferably at the age of 3 months. Wire sutures are passed across from the outer surface of one maxilla to that of the other, and subsequently twisted over lead plates moulded to fit the parts. The wire sutures pass above the palatal processes. If an os incisivum exists, it is pressed back, after its edges have been refreshed and included in the cross wire sutures. The maxillæ are pressed into contact, after the edges of the cleft have been pared, and the wire sutures tightened. The soft palate may require a subsequent operation. (*Figs. 111, 112*.)

ADVANTAGES.—This method is the one which makes a true anatomical restitution. The soft palate will grow into a normal organ, and Brophy claims that speech will not be affected.

DISADVANTAGES.—Mortality is about 11 per cent in infants under one year, but Brophy claims that this is practically the same mortality as that of all infants of the same age dying from various causes, and is due to defective nutrition or gastro-enteritis and not to the operation.

AFTER-TREATMENT.—Feed for one week by a nasal tube. It is wise to have educated the child to this before the operation. Remove the stitches in from ten days to a fortnight.

THE JAWS.

Alveolar Abscess.—Results from a carious tooth. May open on the surface of the alveolus, externally, on the palate, or into the antrum. Often causes periostitis, rarely necrosis.

TREAT by removal of the tooth and opening the abscess.

Epulis.—A growth from the alveolar periosteum or periodontal membrane.

VARIETIES.—False and true.

FALSE.—Granulomatous tissue produced by irritation of dead or carious tooth.

TRUE.—Is a new growth. May be :—

1. *Fibrous.*—Forms polypoid growth.

2. *Fibrosarcomatous.*

3. *Myeloid.*—A benign giant-celled sarcoma. Is locally destructive. Requires complete removal with a portion of surrounding bone.

Epithelioma begins in the gums, or spreads from the cheek or tongue. It rapidly invades the underlying jaw.

Pyorrhæa Alveolaris (Riggs' disease).—A chronic suppuration between the roots of the teeth and the gums. Preceded and caused by a deposit of tartar. The pus forms pockets and sinuses beneath the gum margins. The gums retract from the teeth, and the teeth become loose. It may cause dyspepsia, a chronic sapræmia, and even chronic arthritis or synovitis.

TREATMENT.—Scaling teeth, slitting up sinuses, long-continued daily irrigation with antiseptics. Treatment by vaccine prepared from the infecting organism.

Necrosis of the Jaw.—

CAUSES.—Dental caries and alveolar abscess—Compound fracture of the jaw—Injury and sepsis during teeth extraction—Phosphorus (rare nowadays)—Tertiary syphilis—Tubercle (rare)—Mercury poisoning—Osteomyelitis after exanthemata.

IN PHOSPHORUS JAW.—The disease starts round a carious tooth socket in those who work in the fumes of yellow phosphorus. Great swelling of chronic course results from a new periosteal bone formation. Sinuses open inside and outside the mouth. There is great fœtor, with a tendency to sapræmia, dyspepsia, and septic pneumonia. The sequestrum is grey and porous, and very long in separating. There is strong evidence that this is really a tuberculous caries. The tubercle bacilli have often been demonstrated in the discharge, and the patients usually die of phthisis.

TREATMENT is conducted on general principles.

Cysts and Tumours in the Jaw.—

1. **SIMPLE DENTAL CYST.**—Found in the neighbourhood of the roots of carious teeth, generally the upper first molars and bicuspsids. Probably due to the irritation of an epithelial rudiment of the enamel organ. A painless swelling expands the bone, which presents egg-shell crackling. It contains mucoid material and some epithelial débris (*Fig. 113*).

TREATMENT.—Removal of the tooth, with free opening of the cyst cavity.

2. **FOLLICULAR ODONTOME**, or dentigerous cyst of the jaw, is more common in the lower jaw. It is caused by an expansion of the follicle which contains the developing permanent tooth. Hence it is always associated with the absence of one of the adult teeth. The body of the jaw is expanded and thinned, the bone becoming like parchment. Inside the cavity the crown of the missing tooth is found (*Fig. 114*).

TREATMENT by free opening and emptying.

3. **EPITHELIAL ODONTOME**, or fibrocystic disease of the jaw, usually affects the lower jaw, and in young people. It is caused by a proliferation of the epithelium of the tooth germ or enamel organ in the form of columns of cells resembling an epithelioma, but having a benign course and undergoing a cystic degeneration. A huge mass is formed, which expands the whole body of the jaw, the skeleton of which forms a bony framework for the cysts.

TREATMENT is by removal of a large part of the jaw, usually nearly half the mandible.

4. **FIBROUS ODONTOME.**—An unerupted tooth surrounded by hard fibrous tissue.

TREATMENT.—Complete removal of the tumour.

5. **COMPOSITE ODONTOME.**—A tumour consisting of enamel, dentine, and cement; often laminated. Extremely hard. May be large and invade the maxillary antrum and nasal cavity.

TREATMENT.—Complete removal.

6. **CEMENTOME**—Extremely hard tumour growing from a tooth.
7. **MYELOMA**, when of central origin, may break down to form large blood-cysts. It also produces great expansion of the jaw.
8. **CYSTS OF THE ANTRUM.**—*See* p. 361.

Innocent Tumours.—Fibroma, osteoma, cysts, and polypi.

TREATMENT.—Local removal.

Malignant Tumours.—Sarcoma or carcinoma. Sarcoma is much the commoner. It causes a steady enlargement of the jaw, and if the antrum is invaded there occurs the bulging of its five surfaces: (1) The cheek; (2) The orbital surface with exophthalmos; (3) The nasal surface, with nasal obstruction and epiphora, from blocking of the nasal duct; (4) The palate; (5) The zygomatic surface, producing swelling behind the jaw. Pain is very great and almost constant.

TREATMENT is by excision of the jaw.

Diseases of the Maxillary Antrum.—**SUPPURATION.—**

CAUSES.—Carious teeth, especially the molars and premolars. Suppuration in the nose or accessory nasal sinuses.

SYMPTOMS.—Pain and tenderness, with neuralgia of the infra-orbital nerve. Intermittent discharge of pus from the nose. This may be seen to come from the middle meatus under the middle turbinate bone and above the inferior. It runs out when the patient holds his head forward, and trickles into the pharynx when he lies down. This is due to the fact that the opening into the nose is in the upper part of the antrum.

IN ACUTE CASES the nasal aperture is usually blocked. The symptoms are more severe, and may merge into those of osteomyelitis.

SIGNS :—

PRESSURE SIGNS.—(1) Nasal obstruction and blocking of the nasal duct; (2) Some exophthalmos; (3) Fullness of the palate, with irregularity of the teeth; (4) Swelling of the cheek.

TRANSILLUMINATION by an electric lamp in the mouth shows a darkness instead of the normal rosy colour under the eye.

TRANSIRRIGATION.—A sharp hollow needle is thrust through the nasal wall of the antrum and fluid injected by a syringe. This flows out from the natural opening in the nose, and turbidity of the fluid indicates suppuration.

TREATMENT.—Drain: (1) Through inferior meatal wall, and wash out antrum; or (2) Through canine fossa.

MUCOCELE, or cystic distension.—

CAUSES.—A cystic distension of the glands of the mucous membrane, or the formation of a dental cyst.

SIGNS are merely those of slow painless distension, with atrophy of the anterior bony wall, which gives egg-shell crackling.

TREATMENT as in the last case.

Leontiasis Ossea.—Begins in young adults with no known cause. Consists in exuberant spongy exostoses growing from the cranial and facial bones, especially from the maxilla, mandible, and nasals.

Produces hideous deformity, severe neuralgia, displacement of the eyes, and lastly pressure on the brain.

TREATMENT.—Early removal of the masses as they appear.

Inability to open the Mouth.—

CAUSES.—(1) Ankylosis of the joint, resulting from sepsis, tubercle, or osteo-arthritis; (2) Cicatricial contraction of the soft parts round the joint after injuries or operations; (3) Spasm of tetanus; (4) Reflex spasm from carious teeth, especially an unerupted

Inability to Open the Mouth—Causes, *continued*.

wisdom; (5) Inflammatory swellings inside or outside the joint, e.g., mumps or tonsillitis; (6) Malignant tumours of the parotid or inside the mouth.

TREATMENT is only possible or desirable in the first two cases.

EXCISION OF THE CONDYLE is difficult, and often impracticable.

An attempt may be made to interpose a vulcanite plate or some soft tissues between the bone surfaces to prevent bony union.

ESMARCH'S OPERATION.—Removal of a wedge-shaped piece of bone from the angle of the jaw on both sides, the apex of the wedge being at the alveolar border. The masseter and internal pterygoid muscles are sewn together in the gap so as to prevent bony union.



Fig. 113.—Dental cyst, found at the root of a carious tooth.



Fig. 114.—Follicular odontome (dentigerous cyst). The crown of the unerupted tooth lies in the cavity of the cyst.

CHAPTER XXX.

AFFECTIONS OF THE NOSE.**Fracture of the Nasal Bones.—**

Results from direct violence. One or both bones are broken near their free margin. Or the cartilage is torn from the bones. The septum may be broken at the same time, or it may be the only injury. Surgical emphysema and epistaxis are common complications.

TREATMENT should be undertaken immediately to prevent deformity. The bones are replaced by external pressure, aided by padded forceps internally. A moulded guttapercha splint is fixed over the bridge of the nose by a bandage for a week.

Deviation of the Septum Nasi.—

CAUSES.—External injury—Congenital defects.

SYMPTOMS.—Unilateral nasal obstruction.

TREATMENT.—Submucous resection of the deviated septum.

Flattening of the Bridge of the Nose.—Destruction or impeded growth of the nasal septum.

CAUSES.—Injury, syphilis (usually congenital), tuberculous rhinitis (very rare).

TREATMENT.—Subcutaneous grafting of cartilage and in some cases of bone.

Destruction of the External Nose.—

CAUSES.—Syphilis, lupus, rodent ulcer, epithelioma, or traumatism.

TREATMENT.—

INDIAN RHINOPLASTY.—New nose formed by a flap turned down from the forehead.

ITALIAN METHOD.—Flap formed from the arm and cut from the latter when it has firmly grown on the face.

FRENCH METHOD.—Cheek flaps.

BLOXAM'S OPERATION.—A finger is sewn to the root of the nose after the nail and ungual phalanx have been removed. The soft tissues are split and sewn to the cheeks. Finger is amputated a week later.

Foreign Bodies in the Nose.—Beads, peas, etc., introduced by children, or rhinoliths—calculi formed by the deposit of calcareous salts in chronic rhinitis.

SIGNS.—Nasal obstruction, offensive purulent discharge.

TREATMENT.—Removal either by syringing or by forceps under an anæsthetic.

Rhinitis.—**ACUTE.—**

CATARRHAL.—Ordinary 'cold in the head'.

SEPTIC.—Associated with foreign bodies, septic wounds, and sinusitis.

GONORRHEAL.—Spreads from the lachrymal sac.

DIPHTHERITIC.—Spreads forward from the pharynx.

CHRONIC.—

SPECIFIC.—Lupus, spreads from the face or tear-duct. Syphilis, congenital (snuffles) or acquired.

HYPERTROPHIC.—Causing considerable intermittent or permanent engorgement and hypertrophy of the nasal mucous membrane, chiefly over the inferior turbinate bones.

Signs.—Unilateral or bilateral nasal obstruction. Altered tone to the voice. The inferior turbinate bone appears enlarged, and encroaches upon the inferior meatus of the nose. This enlargement quickly subsides on syringing with cocaine or adrenalin.

Treatment.—Sprays, simple or astringent (e.g., boracic acid or protargol, gr. j ad ʒij). Touching with the electro-cautery. Removal of a part of turbinate bone.

ATROPHIC.—The mucous membrane is dry and shrivelled. The septum is often deflected. Pharyngitis and laryngitis are frequent accompaniments.

Treatment is unsatisfactory.

OZÆNA.—Syphilis and tubercle. Young women. Nasal cavities are enlarged by an atrophy of their walls. Scabs and crusts cover the mucous surfaces. A penetrating nauseous odour is caused, which the patient cannot smell. Sometimes associated with sinus disease.

Treatment.—Copious alkaline douches, followed by oily sprays of liquid paraffin, menthol, etc.

Accessory Sinusitis (*see also* DISEASES OF THE MAXILLARY ANTRUM, p. 361).—The following sinuses open into the nose:—

SPHENOIDAL	{	Into the sphenoidal recess at the highest part of the nasal cavities.
POSTERIOR ETHMOIDAL CELLS		

MIDDLE AND ANTERIOR ETHMOIDAL CELLS	{	Into the middle meatus or the hiatus semilunaris, under cover of the middle turbinate bone.
MAXILLARY ANTRUM		
FRONTAL SINUS		

NASAL DUCT.—Into the inferior meatus.

CAUSES.—Bacterial invasion after catarrh, foreign bodies, operations, exanthemata.

SYMPTOMS AND SIGNS.—

HEADACHE, which is either localized over the sinus, e.g., over the frontal, or general, owing to the proximity to the base of the brain.

NEURALGIA.—From pressure on nerves, e.g., the supra-orbital by frontal disease.

PURULENT DISCHARGE from the nose, which, except in the case of the sphenoidal and posterior ethmoidal sinuses, comes from the middle meatus.

RHINOSCOPY.—A mass of polypi and granulation tissue occupies the place of the middle turbinate bone. Bare bone can often be felt. The swelling of the soft parts does not diminish much by cocaine or adrenalin injections.

RADIOGRAPHY may show a shadow in a frontal or even in a sphenoidal sinus.

TRANSILLUMINATION shows a shadow in the frontal sinus, the lamp being held in the angle of the orbit.

DIFFERENTIAL DIAGNOSIS.—Antral and frontal sinusitis are recognized by the local tenderness, pain, and swelling, and by the evidence of transillumination.

The sphenoidal sinus may give a shadow by the X rays if it is full of pus.

TREATMENT.—

FOR FRONTAL SINUSITIS.—Removal of the anterior wall of the sinus, and draining into the nose.

FOR ETHMOIDAL AND SPHENOIDAL SUPPURATION, an attempt may be made to get at the focus of disease through the nose, after clipping away the middle turbinate bone, or through the os planum of the ethmoid by an incision on the inner wall of the orbit.

MUCOCELE OF THE FRONTAL SINUS.—As in the case of the antrum, the frontal sinus may be distended by a mucous cyst. This causes expansion and thinning of its bony walls, which give an egg-shell crackling. A swelling appears on the forehead, and the eyeball becomes displaced downwards and outwards.

TREATMENT.—Removal of as much of the anterior bony wall as possible, and of all the mucous lining.

Nasal Polypi are of two different origins: (1) Inflammatory; and (2) Neoplastic.

1. MUCOUS POLYPI are merely cedematous granulations hanging from the surface of a diseased ethmoid bone which is affected by rarefying osteitis or caries. They occur in young adults, and cause nasal obstruction, often bilateral. Grow from the middle and superior turbinate bones. They frequently undergo cystic degeneration from the development of cysts in the glands of the mucous membrane covering them. After local removal they recur within a few months.

TREATMENT.—(a) Removal by wire snare under cocaine;
(b) Usually a thorough erosion of the lateral mass of the ethmoid or the opening of a suppurating sinus is required, so as to remove the diseased bone.

Nasal Polypi, continued.

2. **FIBROUS AND SARCOMATOUS POLYPI.**—Consist in all gradations between fibromata and sarcomata, usually beginning as the former and ending as the latter. Occur in children and adolescents most commonly. Grow from the base of the skull and occupy the nasopharynx. Cause nasal obstruction, with sanious discharge.

PRESSURE SIGNS.—The tumour may: (1) Push down the velum palati and cause asphyxia; (2) Expand the nasal cavities and produce a widening of the nasal bridge; (3) Press the eyeballs outwards; (4) Extend into the base of the brain.

IF TUMOUR IS MALIGNANT, secondary growth may occur in the lymph-glands of the neck. In these cases the primary growth is probably a lymphosarcoma of the pharyngeal tonsil.

TREATMENT is possible only in the early stages.

1. Removal by a snare through the anterior nares.
2. Removal through the mouth after splitting the soft palate,
3. Removal from the face after turning up the soft parts and enlarging the anterior nares by temporary displacement of the maxillæ.

Adenoids.—A hyperplasia of the lymphadenoid tissue at the back and roof of the nasopharynx.

CAUSES.—Constitutional delicacy, which causes repeated nasal catarrh. Hygienic defects, e.g., insufficient ventilation. Want of exercise and a consequent slovenly method of breathing.

SIGNS AND SYMPTOMS.—A foliate and more or less symmetrical lymphoid mass fills up the nasopharynx. This can be seen by posterior rhinoscopy and felt by the finger-tip. The size varies from day to day, becoming much larger if the child has a cold. Mouth-breathing. The nasal passages are obstructed and the mouth kept habitually open. It becomes hard and parched. Snoring is marked at night. Discharge of sero-pus from the nostrils and nasopharynx.

RESULTS AND SEQUELÆ.

ON NOSE.—The nostrils become narrow and slit-like, from a falling in of the lateral cartilages. The vomer and septal cartilage become distorted, because the nasal cavities are not large enough for their growth.

ON MOUTH.—The palate is high, narrow, and arched. The teeth are arranged irregularly, being crowded together from insufficient palate growth. This is most noticeable after seven years, when the large permanent teeth are making their appearance.

ON EARS.—The nasopharyngeal catarrh affects the Eustachian tubes, and causes chronic obstruction of these, with deafness, and frequent otitis media and its complications. It is by far the commonest cause of deafness.

ON TRUNK.—The chest, from blocking of the air inlet through the nose, becomes either flat or pigeon-breasted. There is great liability to bronchitis and phthisis. Kyphosis of the spine accompanies this change.

ON THE MIND.—Mental torpor and stupidity occur from defective aeration of the nerve centres, and from the restless and bad sleep produced by the nasal obstruction. The gaping mouth, deafness, dribbling, all increase the appearance of feeble-mindedness.

TREATMENT.—

CLIMATE.—An equable, dry climate like that of Egypt will often cure a slight case.

EXERCISES.—Systematic 'breathing exercises' will cure most cases of adenoids if persisted in for long enough, but in the majority of cases this is quite impracticable.

OPERATION.—Removal by a curette under a general anæsthetic; careful training in nose-breathing is very important afterwards.

Causes of Nasal Obstruction.—

1. SWELLING OF THE MUCOUS MEMBRANE.—

Rhinitis: simple, tuberculous, or syphilitic.

2. OBSTRUCTION DUE TO THE SEPTUM.—

a. SPURS of cartilage and bone growing from the vomerine crest. Treat by cutting through the mucoperiosteum and sawing off the crest.

b. DEVIATIONS of the septum. These may be traumatic in origin, or come from ill-development. Treat by submucous resection if there is no other primary cause of the obstruction.

c. HÆMATOMA and abscess of the septum. Treat by incision.

3. DISEASES OF THE ETHMOID AND OTHER ACCESSORY SINUSES.—See pp. 361, 364.

4. DISEASES OF THE TURBinate BONES.—

a. VASOMOTOR ENGORGEMENT.—Much reduced by cocaine or adrenalin injections. Treat by: (i) Hygienic measures; (ii) Iron and strychnine internally; (iii) Cautey of the inferior turbinate.

b. NASAL CAVITIES ARE SMALL in proportion to the turbinates. Usually unsuited for treatment. Small parts of the front end of the inferior turbinate may be removed by scissors or punch forceps.

c. ENLARGEMENT OF THE MIDDLE TURBinate BONE.—Often associated with severe headache. Treat by removal by the scissors and forceps.

d. MORIFORM HYPERTROPHY of the posterior end of the inferior turbinate. Remove by a snare.

Causes of Nasal Obstruction, *continued*.

5. BLOCKING OF THE CAVITY.—Foreign bodies, polypi, new growths, etc.
6. BLOCKING OF THE POSTERIOR NARES.—Adenoids, fibrosarcomatous polypi.

Epistaxis.—

CAUSES.—Traumatism. After operations. Fractured skull, etc. Ulcer on the septum. Varicose veins. Vasomotor disturbances: (a) In adolescents; (b) In adults with high blood-pressure. Certain blood conditions, e.g., hæmophilia.

TREATMENT—after examination to discover the cause.—

1. Cauterize the bleeding spot if possible.
2. Plug the nasal cavity with gauze soaked in adrenalin.
3. Plugging the nares (anterior and posterior) is seldom required.
4. An inflating plug introduced into the nose and then inflated.
5. Calcium chloride or lactate in drachm doses by the mouth.

CHAPTER XXXI.

AFFECTIONS OF THE TONGUE.

Congenital Malformations.—

ABSENCE OR ARRESTED DEVELOPMENT (very rare).

BIFID OR SPLIT TONGUE may require suture for appearance' sake. TONGUE-TIE, or ANKYLOGLOSSIA.—The frænum is too short, and so sucking and speaking are difficult. It is very rare, though often alleged. Careless division in spurious cases has often caused severe bleeding, septic ulcers, or dangerous tongue-swallowing.

TONGUE-SWALLOWING.—Excessive mobility allows the tongue to fall back, and may cause death by suffocation.

Hypertrophy of the Tongue.—

1. MACROGLOSSIA is a condition of lymphangioma which is usually congenital, but sometimes acquired. Clear vesicles are seen on the surface, usually near the tip, and the whole tongue enlarges. Lymphatic cysts are formed beneath the mucous membrane, the papillæ hypertrophy, and there are also newly-formed blood-vessels and small-round-celled infiltration. The organ is liable to recurrent attacks of glossitis, after each of which it is larger than before. It becomes so large that it cannot be retained in the mouth, and secondary changes take place in the lower jaw.

TREATMENT by V-shaped excision.

2. SIMPLE MUSCULAR HYPERTROPHY may occur in idiots, or without any other lesion.
3. INFLAMMATORY HYPERTROPHY may be seen after any variety of glossitis, but most frequently after syphilitic.

Injuries of the Tongue.—

Wounds are most commonly produced by the teeth, either in epilepsy or eclampsia, or by blows on the jaw when the tongue is protruding. Hæmorrhage is severe, but healing is rapid.

PUNCTURED wounds, as by pipe stems, may have a foreign body in their depth, and this may give rise to severe secondary hæmorrhage, or to chronic inflammatory thickening.

Acute Parenchymatous Glossitis occurs generally in adult men. Cold, mercurialism, and debility are predisposing causes.

Rapid painful swelling takes place, which makes speech and swallowing, or shutting the mouth, impossible.

Death may occur from asphyxia or sepsis, but recovery is the rule, with some superficial sloughing.

TREATMENT in bad cases is by free longitudinal incisions.

Acute Parenchymatous Glossitis, continued.

STREPTOCOCCAL GLOSSITIS begins in the neighbourhood of the submaxillary gland, and ends as a rapid cellulitis of the neck, with œdema of the glottis.

TREATMENT by antistreptococcal serum and tracheotomy.

STAPHYLOCOCCAL GLOSSITIS usually results from wounds and injuries. An indurated swelling forms, which develops into an abscess deep in the tongue substance.

TREATMENT.—Free opening in the mouth, or, in deep cases, through the mid-line of the neck above the hyoid.

MERCURIAL STOMATITIS is accompanied by bad breath, spongy gums, and superficial sloughing.

TREATMENT is by chlorate of potash, with astringent gargles.

GANGRENE may result from acute glossitis, or as an extension from cancrum oris. In the former case natural cure by the separation of the slough is the rule.

Superficial Glossitis occurs in many septic mouth conditions and in dyspepsia and gout.

SIMPLE OR DYSPEPTIC.—The tongue becomes indented by the teeth, and in bad dyspeptic cases it is raw and excoriated.

TREATMENT by chlorate of potash, and that for the dyspepsia.

HEMIGLOSSITIS is rare, and usually of nervous origin and accompanied by herpes.

APTHOUS GLOSSITIS, OR THRUSH, occurs in infants from the growth of the *Oidium albicans*. The tongue and mouth become red, and then are covered with white patches, which consist of masses of the organism. It is very contagious among children.

TREAT by care of milk supply, cleaning the mouth with alkaline and boracic washes.

ERYTHEMA MIGRANS, or wandering rash, occurs rarely and in debilitated children. Red, smooth patches are seen, surrounded by a raised yellow border. The latter spreads like ringworm, and neighbouring rings may intersect. It causes itching and salivation, and is very chronic.

No special treatment is available.

HERPES is most common in neurotic women. It is very painful, leaves troublesome ulcers, and is prone to repeated recurrences.

TREATMENT by application of cocaine or of carbolic acid.

Chronic Superficial Glossitis.—

LEUCOPLAKIA OR LEUCOKERATOSIS.—

ETIOLOGY.—Only occurs between twenty and sixty, and very rarely in women. Syphilis, smoking to excess, especially rough pipes, taking raw spirits and hot foods, gout, rheumatism, and dyspepsia, are all predisposing causes.

PATHOLOGY.—Papillæ disappear. A layer of small round cells appears between the Malpighian layer and epidermis, and latter becomes horny. Pathological types :—

1. *Swelling of Papillæ.*
2. *Leucoplakia.*—Overgrowth and cornification of epithelium.
3. *Raw Glazed Tongue.*—Epithelium is shed, leaving raw tongue without any papillæ.
4. *Cracks and Fissures.*—Due to contraction of fibrous tissue, leaving fissures in furrows. This is the pre-carcinomatous stage.
5. *Epithelioma.*—Frequently follows.

SYMPTOMS.—The tongue feels hard and dry, and thirst is prominent. Tenderness and rawness are felt, especially when the patch is denuded of its covering, when ulcers, warts, and fissures are apt to form.

COURSE.—Lasts many years and is practically incurable. Various stages of the disease may co-exist. It frequently gives rise to epithelioma.

TREATMENT.—Avoiding smoking, and sweet, sour, sharp, or strong articles of diet. Alkaline gargles, borax and glycerin, and also boracic or eucalyptus ointment, put on at night after carefully drying the tongue. Also chromic acid, gr. v ad ʒj. Excision of limited patches, warts, ulcers, or fissures. Radium has been used successfully.

SMOKERS' PATCH.—Localized area of leucoplakia from which the heaped-up epithelium has been shed.

HYPERKERATOSIS (or Black Tongue).—Patch of epithelium in the mid-line in front of the circumvallate papillæ becomes dark or black, and the papillæ enlarge to form long waving hairs. The colour is due to micro-organisms.

No special treatment is required.

Simple Ulcers occur in superficial glossitis, and are very intractable when they become chronic.

PAINT with chromic acid, and **Excise** if they do not heal at once, lest cancer occur.

Herpetic Ulcers occur in children or young adults as an acute condition, with some malaise, as a vesicular eruption, followed by ulceration.

Chlorate of potash is the best **TREATMENT**.

Irritation Ulcers affect edges of the tongue adjacent to broken carious teeth or badly-fitting tooth-plates. Ragged and sloughy base and edges. No induration at base. Rapidly heal when tooth is removed. If left may be the starting-point of epithelioma.

Dyspeptic Ulcers.—Generally on the dorsum near the tip. Associated with a severe grade of dyspepsia. Shallow and indolent. No induration. Painful.

TREAT the dyspepsia, and paint ulcer with lunar caustic.

Mercurial Ulcers occur after the separation of superficial sloughs, with all the fœtor and other signs of stomatitis.

Taberculous Ulcers.—Complicate phthisis or lupus. Especially near tip. Left by the breaking of an abscess. Shallow ulcer with sharp cut edges and no induration. The surface is pale and flabby. Very painful.

TREAT by excision under cocaine.

Syphilis of the Tongue.—

PRIMARY.—As in lip chancre. Much matting and enlargement of glands. Much infiltration of the base, but not much induration.

SECONDARY.—Shallow, multiple, painful, small ulcers, especially round the edges and under surface. Mucous patches and condyloma (Hutchinson's wart).

TREAT by painting with chromic acid, gr. x ad ʒj, over ulcers.

TERTIARY.—

1. **CHRONIC SUPERFICIAL GLOSSITIS.**

2. **DIFFUSE FIBROUS THICKENING** of the tongue. Chronic interstitial glossitis, generally combined with (1). Tongue is large and hard. Distorted by furrows and fissures. Caused by fibrous tissue drawing in the surface in folds and furrows.

3. **GUMMA WITH ULCERATION.**—Patient is generally about forty. Begins as a swelling in the tongue substance. In mid-line, far back, is common situation, or at the side. Breaks and discharges 'gummy material'. Quite painless ulcer is left. Base formed by tough slough (like wet wash-leather). Sharply-cut edges—'punched-out'. No induration of the base. No fixation of the tongue. No enlargement of glands. Remains stationary a long time. Scar may give rise to epithelioma.

Simple Tumours of the Tongue and Floor of the Mouth.

SALIVARY GLAND TUMOURS may grow from the submaxillary, sublingual, or incisive glands. The majority are endotheliomata, and consist of endothelial columns and cartilage.

RANULA is an obstructive or retention cyst, usually of the sublingual, rarely of the incisive glands (*see* p. 378).

SALIVARY CALCULUS, with surrounding inflammation, may be impacted in Wharton's duct, and form a hard swelling.

DERMOID CYSTS are usually in the mid-line in the floor of the mouth, between the mylohyoid and geniohyoglossi. These are sequestration dermoids. They may be lateral near the angle of the jaw, in which case they are probably tubulo-dermoids from a branchial cleft. They form a firm, elastic, yellow swelling, which projects below the chin.

TREATMENT by excision through the mouth in most cases.

PARASITIC CYSTS.—Cysticercus and hydatid cysts are extremely rare.

LINGUAL TONSIL may be chronically enlarged or subject to a follicular abscess. In either case surgical treatment, excision or incision, will be required.

THYROGLOSSAL DUCT TUMOURS AND CYSTS.—These occur in two situations: (1) At the back of the tongue in the foramen cæcum, as a tumour or a cyst, which is red, vascular, and about the size of a pea or cherry, and has the structure of a thyroid adenoma; (2) In the substance of the tongue near the hyoid bone, in which case they form cysts lined by ciliated epithelium, and containing mucus.

BLOOD-CYSTS of the tongue are due to hæmorrhage taking place into these.

TREATMENT is by excision.

LIPOMA may be: (1) Congenital, when it is large and deep-seated; (2) Superficial and small, occurring in old people, and becoming polypoid; (3) Deep-seated, occurring in late life, between the tongue and floor of the mouth.

FIBROMA.—Either polypoid or deep-seated. Is painless and of very slow growth.

ANGIOMA.—This may be arteriovenous, capillary, or cavernous, the last being the largest and most important. Usually congenital.

Excision will be required to avoid ulceration and hæmorrhage.

PAPILLOMA occurs in children and adults as a simple new growth, and also in cases of superficial glossitis, when it is a precursor of cancer. It should always be removed.

Sarcoma of the Tongue is a very rare disease. It occurs in young adults as an elastic mass in the tongue substance. Its nature is seldom recognized until removal has been done. In some cases it is encapsuled and comparatively benign, but in others (lymphosarcoma), which begin in the lingual tonsil, malignancy is well marked.

EPITHELIOMA OF THE TONGUE.

Etiology.—Much commoner in men, i.e., about 85 per cent. Occurs generally between forty and sixty. Caused by rough pipe, much smoking, irritation ulcer, syphilitic scars, etc., and also the injudicious use of caustics.

BEGINS as:—

1. **WARTY OUTGROWTH**, often in chronic glossitis.
2. **AN ULCER** at edge, at junction of middle and posterior third. Probably from a rough tooth. On the dorsum in glossitis or syphilis.
3. **CRACK OR FISSURE**, especially in chronic glossitis.
4. **SUBMUCOUS INFILTRATION** (very rare).
5. **EXTENSION** from tonsils or larynx.

Signs and Symptoms.—Usually begins on the anterior two-thirds, and towards the edges. Crateriform ulcer, or a warty growth. Hard, everted (rolled-over) margins. Sides slope down to a ragged, foul base. Bleeds on touching. Profuse foetid discharge and profuse salivation. Base of the ulcer is very indurated. Glands in the neck hard and enlarged after about six months.

Epithelioma of the Tongue—Signs and Symptoms, *continued*.

LATER.—Pain is very marked; often localized in the ear. Saliva constantly dribbles from the mouth. Tongue cannot be protruded owing to the involvement of intrinsic muscles. Glands in the neck form a huge mass.

Extension.—To the fauces and tonsils—Gums and lower jaw—Floor of the mouth.

Secondary Deposits.—

GLANDULAR.—The lymphatic glands of the neck are invaded generally within the first six months of the disease, and often before that. The submental and submaxillary groups are involved first, with growths at the tip or sides of the tongue; and the carotid group, extending from the skull to the sternum, is affected later. The most constant position is at the carotid bifurcation. Usually in the early stages only the glands of the same side as the growth are affected, but later those of the opposite side become involved. (*Fig 115.*)

VISCERAL.—The liver, lungs, heart, suprarenals, and other viscera are affected with extreme rarity.

Complications.—

GLANDS IN NECK.—Form large cystic swellings. Break and form foul septic ulcers. Cause death by tracheal pressure, or by pressure dysphagia.

SEPTIC PNEUMONIA.

SECONDARY HÆMORRHAGE.

Course.—Patient generally dies within one year.

Diagnosis.—

From **OTHER ULCERS.**—*See* pp. 371, 372.

From **ACTINOMYCOSIS.**—Pus, with characteristic granules.

From **INFLAMMATION ROUND SALIVARY CALCULUS.**—

Although there may be great induration, there is no real fixation. An incision will reveal the stone.

Every ulcer, wart, or fissure which does not at once yield to local or specific treatment should be removed and examined for epithelioma.

Treatment.—Removal of tongue and glands, except in following:—

1. Base of tongue so infiltrated on both sides that it cannot be moved.
2. Extensive involvement of the fauces.
3. Involvement of larynx.
4. Extensive involvement of jaw.
5. Glands fixed to great vessels and trachea.

Operations for Cancer of Tongue.—

PRELIMINARY to all operations.—Remove carious teeth or stumps. Scale and clean the remaining teeth. Rub off all fur possible from the tongue with dilute antiseptics. Treat any dyspepsia. Spray mouth with 1-80 carbolic, or 1-2000 biniodide of mercury, or protargol and glycerin 1 per cent solution.

IN BAD CASES, i.e., where operation is a very extensive one, where there is a foul fungating mass, a preliminary injection of streptococcal serum may be given as a prophylactic.

1. WHITEHEAD'S OPERATION.—

INDICATIONS.—Tongue must be able to be protruded.

METHOD.—Transfix tip by two threads. Split the tongue down the raphe. Cut through mucous membrane in floor of mouth. Cut through median part of tongue and tie the lingual artery. Cut through faucial pillars and root of tongue. Remove both halves if growth has deep induration or is near mid-line. Powder the stump with iodoform.

Two or three weeks after excision, all the lymphatics should be removed from the carotid and submaxillary triangles of the same side of the neck together with the deep fascia (Butlin). Or a block of tissue may be removed including the sternomastoid muscle and the internal jugular vein (Crile).

2. KOCHER'S, OR LATERAL EXTRABUCCAL, OPERATION.—

INDICATIONS.—When root of the tongue is involved—The tongue cannot be protruded—The jaws or fauces slightly involved.

METHOD.—Incision from lobule of ear to great cornu of hyoid bone, along hyoid bone, up to symphysis. Remove glands and tie the lingual or external carotid. Remove diseased alveolus if necessary. Cut through mylohyoid muscle. Bring tongue into the neck. Remove it as far back as epiglottis, and cut down to hyoid bone. Tie opposite vessels as they are cut. External incision closed with drainage.

3. SYME'S, OR MEDIAN EXTRABUCCAL, OPERATION.—

INDICATIONS.—Floor of the mouth involved. Disease spreading to symphysis menti.

METHOD.—Incision from margin of lower lip down over the chin to the middle of the hyoid bone. Two perforations through the jaw at the sides of mid-line. Cut the jaw into two halves, or remove diseased part of jaw. Draw the tongue out. Cut through with scissors from below backwards and upwards. Tie vessels one by one as met. Wire the two halves of the jaw together. Sew up the external incision.

IN REMOVAL OF THE WHOLE TONGUE BY ANY METHOD:
PRECAUTIONS.—

PRELIMINARY TRACHEOTOMY.—At the time of operation, or a few days previously. Use Hahn's tube surrounded by sponge, or a dilatable jacketed tube, or plug pharynx with a sponge. Or LARYNGOTOMY at the time. Easier—Quicker—Heals more rapidly afterwards.

Or INTRATRACHEAL ANÆSTHESIA.—The anæsthetic is given by a catheter passed down through the larynx. The constant stream of outgoing air prevents blood or other fluid from entering the trachea.

Operations for Cancer of Tongue—Precautions, *continued*.

SECURE THE STUMP BY A THREAD fixed to the cheek to prevent asphyxia.

AFTER-TREATMENT.—Leave the tracheotomy tube in place two to seven days in bad cases. Powder the inside of mouth with aristol or iodoform, and wash out frequently with Condy or 1-80 carbolic. If temperature rises, give 30 c.c. antistreptococcic serum. Feed by rectum for twenty-four hours, by oesophageal tube for six days.

CAUSES OF DEATH AFTER OPERATION.—Shock—Recurrent or secondary hæmorrhage—Asphyxia from falling back of the stump on the larynx—Septic pneumonia—Septicæmia.

OPERATION RESULTS.—Immediate mortality: intrabuccal operation, 7 per cent; extrabuccal operations, over 20 per cent. Cases alive at the end of three years without recurrence, 20 per cent.

RECURRENCE usually takes place in the stump within six months, or in the cervical glands at a later period.

REMOVAL BY DIATHERMY.—A cancer of the tongue may be removed by application of diathermy. This high-frequency current destroys all tissue to the depth of about half an inch from the point of application of the electrode. Its advantages are: absence of hæmorrhage, comparative painlessness, absence of shock. It is especially suitable for large fixed growths.

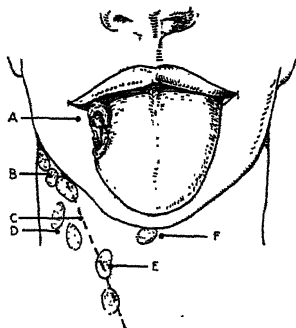
Radium.—Burying radon seeds or inserting radium needles around the primary growth may produce highly satisfactory results, and is likely to replace the older methods of excision. The glands are not materially affected by the radium and should be removed.

Palliative Treatment.—Removal of carious teeth, and keeping the mouth clean with antiseptics, e.g., hydrarg. bichyanide 1-1000.

FOR PAIN.—Insufflation with powder containing morphia or orthoform. Packing ulcers with iodoform gauze. Excision of lingual nerve. Lastly, morphia by hypodermic injections.

FOR SALIVATION AND FÆTOR.—Atropine as an injection, and iodoform locally.

Fig. 115.—Diagram of epithelioma of tongue and glands. A, Growth starting at lateral border of tongue; B, Glands at angle of jaw; C, Line of sternomastoid muscle; D, Carotid glands, upper set; E, Carotid glands, lower set; F, Submental glands.



CHAPTER XXXII.

AFFECTIONS OF SALIVARY GLANDS,
TONSILS, PHARYNX, AND ŒSOPHAGUS.

AFFECTIONS OF THE SALIVARY GLANDS.

Parotitis.—

VARIETIES.—(1) Acute; (2) Chronic.

1. ACUTE.—

- a.* NON-SUPPURATIVE.—Epidemic parotitis or mumps: Infectious, and affects usually children; both glands are generally affected by a parenchymatous inflammation which never suppurates. Often coincident (or metastatic) inflammation of the genital organs: testis, breast, or ovary. Occurs in this order of frequency.

TREATMENT is medical.

- b.* SUPPURATIVE.—Usually an ascending duct infection from mouth, but may be pyæmic, a blood infection from any distant septic focus. Duct infection occurs with the dry septic mouth in patients following operation, and during fevers. Also because of the diminished salivary flow from the absence of food stimulus.

TREATMENT.—Fomentations, and early incisions parallel to the zygoma so as to avoid injury to the facial nerve.

2. CHRONIC.—(*a*) Simple. (*b*) Actinomycosis. (*c*) Tuberculosis. (*d*) Syphilis. The last three are very rare.

ETIOLOGY.—Caused by infection from the mouth.

SYMPTOMS.—Painful swelling of the gland.

TREATMENT.—Massage, or injection of lipiodol into the duct.

Inflammation of the other salivary glands is rare, and calls for no comment.

Salivary Calculus is common in Wharton's duct, but rare in Stenson's. It forms a hard swelling in the floor of the mouth, and may lead to salivary obstruction or fistula. It has been mistaken for epithelioma.

TREATMENT.—Excision through the mucous membrane.

Salivary Obstruction may be due to: (1) Calculus; (2) Cicatrization; or (3) Injury. Rare, except in the submaxillary gland.

SYMPTOMS.—Painful swelling of the gland after meals.

TREATMENT.—By removal of the obstruction, or of the gland.

Sialography.—One to two c.c. of lipiodol are injected into Stenson's duct. An X-ray will then show deformities or dilatations of the ducts or acini.

Salivary Fistula.—Is rare, except in Stenson's duct. Caused by operation wounds and injuries.

TREATMENT by passing sutures, or drainage tubes, from the intrabuccal opening to the fistula.

Tumours of the Salivary Glands.—

RETENTION CYST or RANULA is very common in the sublingual, and very rare in the other glands. Consists of a mucocele, which may be a pure retention cyst, or a new growth. Forms a bluish swelling in the floor of the mouth, and is always unilateral. Wharton's duct overlies it.

TREATMENT is by excision.

SIMPLE TUMOURS.—These, as well as malignant growths, occur commonly in the parotid, and rarely in the submaxillary glands. They are usually of a complicated structure, and are now regarded as **ENDOTHELIOMATA**. Simple fibroma or adenoma is rare. The tumours contain proliferating columns of endothelium which undergoes mucoid degeneration, and in which cartilage is commonly developed. Hence, various admixtures of adenoid, fibroid, chondroid, and mucoid tissues are found.

SIGNS.—A firm elastic or cystic swelling, which moves freely, and is usually limited by the zygoma, anterior margin of the masseter, sternomastoid, and angle of the jaw.

SYMPTOMS.—Usually painless, but unsightly. Quite slow in growth.

TREATMENT is by excision.

VON MIKULICZ' DISEASE.—Chronic symmetrical enlargement of all the salivary glands, and including the lachrymal glands. The pathology is unknown. It is probably a chronic inflammation, and not a new growth.

TREATMENT.—Arsenic, iodides, and X rays.

MALIGNANT TUMOURS.—These are usually endotheliomata which have become malignant, but primary sarcoma or carcinoma may also occur.

SIGNS.—Fixation of the tumour to the skin and underlying tissues. Facial paralysis from involvement of the facial nerve. Extension into the zygomatic fossa and encroachment upon the mouth and pharynx.

TREATMENT is by excision, but this is only possible if the case is seen early.

AFFECTIONS OF THE TONSILS.

Acute Tonsillitis.—According to the part involved this may be: (1) Follicular; (2) Parenchymatous; (3) Superficial. But this distinction is probably quite artificial and unnecessary.

FOLLICULAR TONSILLITIS is the usual form.

CAUSES.—Sepsis, sewer-gas, contact with septic wounds (hospital throat), septicaemia, scarlet fever, rheumatism, chronic enlargement of the tonsils.

SYMPTOMS.—Swallowing is very painful, the glands enlarge under the jaw, and the temperature rises to 103–105° F.

SIGNS.—Both tonsils become swollen and inflamed, and all their lacunæ filled with mucus, which may also form a membrane over the surface.

DIAGNOSIS must be made from scarlet fever by absence of rash.

TREATMENT.—Salicylate of soda pushed to deafness. Chlorate of potash gargles.

Peritonsillitis or Quinsy.—Suppuration in or round the tonsil, usually the latter, occurring between the tonsil and its bed.

SIGNS.—Bright red swelling of the fauces and soft palate, usually much more marked one side than the other. The tonsil itself is often buried in the swollen faucial pillars. Inability to swallow is almost absolute, and the pain and constitutional disturbance are severe. If left alone, about eight days elapse before the abscess bursts, which it generally does through the soft palate or anterior faucial pillar. Rapid recovery follows. Fluctuation and pointing of the abscess can be seen and felt with difficulty, because the patient cannot open the mouth.

TREATMENT.—An incision directly a soft spot can be found. This generally has to be made through the soft palate, and runs parallel to the anterior faucial pillar.

Chronic Tonsillitis. Hypertrophy.—

CAUSES.—Sepsis, cold, debility, insufficient exercise. A previous attack of acute tonsillitis makes recurrent attacks the rule, especially in adults, and after each of these the tonsils are larger than before.

STRUCTURE AND ASSOCIATED CONDITIONS.—The enlarged tonsils may: (1) Stand out as protuberant masses which almost touch one another; or, (2) They may lie deeply concealed within the faucial pillars. Above the tonsil and between the faucial pillars is a recess, the supratonsillar fossa, into which the upper follicles open. The large follicles show open mouths, or these may be plugged with bacterial and mucoid debris. A lobe runs down on to the lateral surface of the tongue. In children the pharyngeal tonsil is generally also enlarged (*see* ADENOIDS, p. 366).

SYMPTOMS.—Thickness of speech. Mouth-breathing is common because of the adenoids. Liability to repeated acute attacks of tonsillitis is the most serious result. Also considerable debility may result from the chronic septic absorption.

TREATMENT.—

THE GUILLOTINE is the routine method of treatment, gas being necessary for children, and cocaine for adults. In many cases of deeply-seated tonsils this method of removal is very inadequate, because all that part which lies deep to the faucial pillars is left, and subsequently causes a recurrence of the symptoms. This can be avoided in some cases by making traction on the tonsil with a vulsellum before driving home the guillotine.

Chronic Tonsillitis—Treatment, continued.

ENUCLEATION is the ideal method, but always requires an anæsthetic. The finger is placed in the supratonsillar fossa, and the tonsil shelled out from its bed, and then twisted or cut off. Bleeding is not severe, because the vessels are torn rather than cut. The danger of wounding the internal carotid is quite mythical, since the vessel lies three-quarters of an inch away from the bed of the tonsil the other side of the pharyngeal wall.

Syphilis of the Tonsil may be: (1) Primary (very rare); (2) Secondary superficial ulcers, which are common; (3) Gummata, or late tertiary ulceration, which cause great scarring and deformity.

New Growths of the Tonsil.—**VARIETIES.—**

EPITHELIOMA, which usually begins in the fauces or tongue.

LYMPHOSARCOMA occurs at any age, but usually in young people, and is intensely malignant.

MIXED-CELLED SARCOMA is rarer.

SIGNS AND SYMPTOMS.—Rapid enlargement without pain or inflammation. In the case of epithelioma, deep ulceration soon occurs. In that of a sarcoma the mass is elastic, soft, and encapsuled at first. In all, the submaxillary cervical lymph-glands rapidly become enlarged. Dysphagia, asphyxia, or secondary hæmorrhage are the usual causes of death, which occurs within one year.

TREATMENT.—REMOVAL through the neck with all the lymph-glands of that side that can be found. The incision is that of Kocher's tongue incision, and the external carotid is tied.

AFFECTIONS OF THE PHARYNX.

Acute Pharyngitis is caused by septic absorption, and often accompanies scarlet fever, septicæmia, rheumatism, and syphilis. Pain, swelling, and redness of the fauces and mucous membrane, with dysphagia. In septic cases, œdema of the glottis may occur and cause asphyxia.

TREATMENT.—Inhalation of steam impregnated with carbolic or balsamic vapours. Salicylates by mouth. Multiple incisions in cases threatened by asphyxia.

Chronic Pharyngitis is caused by smoking, drinking raw spirits, over-use of the voice, e.g., in clergymen and hawkers. The vessels become atonic and dilated, and nodules of lymphoid tissue become prominent. An excess of sticky mucus is secreted, which is tenacious and causes hawking and retching.

IN THE FOLLICULAR VARIETY the enlarged lymphoid nodules are prominent.

IN THE ATROPHIC VARIETY the mucous membrane is smooth and glazed, and may be covered by crusts.

TREATMENT.—

AVOIDANCE of speaking, smoking, and drinking alcohol.

SPRAYS of tannic acid, perchloride of iron, or protargol, in glycerin, or oily sprays containing menthol, eucalyptus, etc. GALVANO-CAUTERY POINT to all the large lymph-follicles.

Post-pharyngeal Abscess.—

ACUTE.—Due to septic infection through abrasions, e.g., swallowing a fish bone. Caused by pyogenic organisms, and develops between the pharynx and the prevertebral fascia. May cause asphyxia by suddenly bursting into the larynx. Forms a tender, fluctuating swelling at the back of the throat.

TREATMENT.—Incision through the pharyngeal wall, care being taken that the pus does not enter the larynx.

CHRONIC.—Due to tuberculous disease of the upper cervical vertebræ. It forms with little pain or inflammation, deep to the prevertebral fascia, behind which it tracks out into the neck.

TREATMENT.—Open by an incision behind sternomastoid, before bursting or septic infection through the mouth has occurred.

Syphilis of the Pharynx.—(1) Secondary, in the form of superficial mucous patches, or snail-track ulcers; (2) Tertiary, in the form of submucous gummata and deep ulceration, which in the process of healing causes great deformity by tying down the soft palate to the pharyngeal wall.

Stenosis of the Pharynx.—Due either to cicatrization after scalds, or most often after syphilis. In the commonest type, the remains of the soft palate are so bound down to the posterior pharyngeal wall that the nasopharynx is shut off from the mouth. In the more serious type, fauces, soft palate, and posterior walls are contracted so as to constrict the passage from mouth to œsophagus.

TREATMENT.—Division of the stricture and passage of bougies. If this fails, œsophagostomy will be required in severe cases.

Epithelioma is the only primary growth of the pharynx, and as a primary growth is rare. Its appearance, course, and treatment are similar to those of the disease at the back of the tongue.

Pharyngeal Pouch or Propulsion Diverticulum is a hernial protrusion of mucous membrane between the transverse and oblique portions of the inferior constrictor of the pharynx. Is usually found in adults about thirty. Lies usually on the left side. Causes dysphagia by pressure.

TREATMENT.—Excision from left side of neck.

AFFECTIONS OF THE ŒSOPHAGUS.

Malformations.—

CONGENITAL.—

Fistulous communication with trachea.

Stricture at the cardiac orifice of the stomach.

ACQUIRED.—

TRACTION DIVERTICULA.—Small pouches on anterior wall. Near tracheal bifurcation. Caused by traction of adherent glands. Produce no symptoms. May cause lodgement of foreign body.

Foreign Bodies in the Œsophagus.—Coins, tooth-plates, pins swallowed accidentally, usually by children or lunatics.

CHARACTERS OF FOREIGN BODY which are important :—

SIZE, causing blocking at the entrance, with fatal dyspnoea from pressure on larynx.

IRREGULARITY, causing it to catch and be impacted in the wall.

SHARP POINTS, causing perforation.

RESULTS.—

PASSAGE per vias naturales, especially with small, round, smooth bodies.

IMPACTION, especially in the case of large or irregular bodies.

Position of impaction : Opposite the larynx (6 inches from teeth) ; opposite tracheal bifurcation (12 inches from teeth) ; at lower end (18 inches from teeth).

ULCERATION of the gullet, resulting in cellulitis of the neck, or mediastinitis ; opening into the trachea ; opening into a large vessel, with fatal secondary hæmorrhage.

MIGRATION to a distance along fascial planes, in the case of pins or needles.

SYMPTOMS of foreign body in œsophagus—Dysphagia—Dyspnoea, especially if the neighbourhood of the larynx is involved.

LATE SYMPTOMS.—Pain from ulceration and inflammation—Hæmorrhage.

TREATMENT.—

LOCATION BY : Inspection of fauces—Inspection by œsophagoscope—Digital exploration—X rays.

REMOVAL via œsophagoscope. Failing that, by left-sided œsophagotomy. Attempts to remove foreign bodies with the aid of a coin catcher or probang are dangerous.

Œsophageal Obstruction.—

CAUSES.—

EXTRINSIC : Tumour in neck (e.g., goitre)—Tumour in thorax (e.g., aneurysm)—pressing on the gullet.

INTRINSIC : Spasm—Impacted foreign body—Fibrous stricture—Malignant stricture.

Spasm of the Œsophagus.—May be hysterical ; or a permanent neuromuscular overaction with hypertrophy, so-called *cardio-spasm*. Latter may be treated by opening stomach and dilating lower end of the gullet by fingers, or by a plastic operation.

Fibrous Stricture of the Œsophagus.—Usually in middle-aged men. At upper or lower end of the gullet. Caused by the contraction of corrosive ulcers ; possibly by syphilitic ulcers.

SYMPTOMS.—Dysphagia—Regurgitation of little altered food—Little or no bleeding on passing a sound—Slow in its development.

TREATMENT.—

PASSAGE OF TWO OR THREE SIZES OF BOUGIE once a week.

SYMONDS'S TUBE.—Passed on a whalebone guide. Retained, with a thread fixed to the cheek for the purpose of periodical removal.

DIVISION OF THE STRICTURE, followed by bougies.

From the mouth : By a concealed knife cutting backwards.

Only suitable for high strictures.

From the stomach : By forcible dilatation of stricture.

Only possible for stricture of lower end.

By string saw : Patient swallows a string. Lower end is pulled out of stomach. Pulled up and down.

ŒSOPHAGOSTOMY.—When the stricture is high up. Œsophagus is sewn into left side of neck.

GASTROSTOMY for worst cases.

Malignant Disease of the Œsophagus.—Patients over forty-five ; usually men.

SITUATION AND VARIETY.—

1. OPPOSITE THE CRICOID CARTILAGE—6-8 inches from the teeth, 15 per cent.
2. OPPOSITE TRACHEAL BIFURCATION—12 inches from the teeth, 32 per cent. In both of these the growth is an epithelioma. The epithelioma presents no cell nests.
3. AT THE CARDIAC EXTREMITY—18 inches from the teeth, 52 per cent. Growth is a columnar-celled carcinoma.

SYMPTOMS.—Dysphagia. Inability to swallow solids and, later, liquids. Regurgitation of more or less altered food. This is not so marked as in fibrous stricture, because there is not time enough for dilatation above the growth. Pain and cough. Vomiting of blood. Very rapid emaciation.

PHYSICAL SIGNS.—Growth may be seen by an œsophagoscope. Auscultation detects a gurgle over the spine opposite the stricture on swallowing fluid.

EXTENSION AND COMPLICATIONS.—Early ulceration—Invasion of trachea, bronchi, great vessels—Metastatic growths in the glands.

OTHER COMPLICATIONS.—Septic pneumonia, from perforation of the air-passages. Aphonia from involvement of the larynx. Laryngeal paralysis, from involvement of the recurrent laryngeal nerves. Cellulitis, or mediastinitis.

COURSE.—Death from inanition, 6-12 months.

TREATMENT.—

1. RADICAL TREATMENT.—Direct action with removal has been attempted, but is prone to failure owing to (a) Age of patient ; (b) Lateness of symptoms ; (c) Difficult and dangerous approach. Only suitable for cricoid cases.
2. PALLIATIVE TREATMENT.—Aims at overcoming the obstruction. Methods :—
 - a. Insertion of a Souttar's tube (spiral of German silver wire) ; this is preferable to a Symond's tube.
 - b. Diathermy and radium results have been disappointing.
 - c. Gastrostomy for late cases.

CHAPTER XXXIII.

AFFECTIONS OF THE NECK.

CYSTS OF THE NECK.

Congenital.—Often do not appear until adolescence.

1. DERMIODS.—

UNDER THE STERNOMASTOID:—

BRANCHIAL TUBULODERMIODS (*Fig. 116*).—May open along anterior border of sternomastoid as branchial fistulæ. May become malignant—branchial carcinoma.

IN MID-LINE:—

ORDINARY SEQUESTRATION DERMIODS.

THYROGLOSSAL DUCT CYSTS.—From thyroid duct—Foramen cæcum in tongue—Base of tongue or floor of the mouth—Behind hyoid bone—In front of larynx or trachea.

Adenomata may arise from their walls in any situation. They may open as a median fistula. Generally in mid-line low down near sternum.

2. CYSTIC HYGROMA.—Large shapeless mass of dilated lymph-spaces. Whole of the side of the neck and face, and down into the thorax. Not limited by any anatomical boundaries.

Acquired.—

SEBACEOUS CYSTS.—Fixed to the deep skin surface.

BURSAL CYSTS.—Over thyroid cartilage—Between hyoid and thyroid.

HYDROCELE OF THE NECK.—Probably a lymph cyst. Under the sternomastoid, and extends into posterior triangle.

BLOOD CYSTS.—Aneurysm—Venous varix—Cyst communicating with vein.

GLANDULAR CYSTS.—Thyroid: move with deglutition. Salivary: rare except in the floor of mouth.

MALIGNANT CYSTS.—From branchial dermiods—From breaking down glands the seat of secondary epithelioma—From endothelioma of carotid gland.

HYDATID CYSTS.

CUT THROAT.

SUICIDAL.—Generally from left to right—More severe on left side.

HOMICIDAL.—Vary in position and extent.

Varieties.—

1. Those not opening pharynx or air-passages. Nothing special.
2. Those involving the air-passages—Above hyoid—Through thyrohyoid space—Into larynx—Into trachea.

Primary Effects.—

ABOVE HYOID.—Wound of lingual and facial vessels. Injury of root of tongue. Danger of asphyxia from tongue falling over larynx.

THYROHYOID SPACE.—Wounds of lingual, facial, and superior thyroid vessels over larynx. Injury of epiglottis. Bleeding into larynx.

LEVEL of LARYNX.—Injury to the vocal cords or lobes of thyroid gland.

BELOW LARYNX.—Hæmorrhage from thyroid gland and vessels—Trachea opened—Asphyxia from displacement of the cut ends or from bleeding into the trachea—Wounds of great vessels, with fatal hæmorrhage—Air drawn into veins—Division of recurrent laryngeal nerve.

Remote Effects.—Septicæmia or pyæmia—Cellulitis leading to mediastinitis—Edema of glottis—Secondary hæmorrhage—Tracheitis, bronchitis, septic pneumonia—Passage of food into trachea—Surgical emphysema.

Treatment.—Arrest the hæmorrhage. Sew up, with free drainage. If larynx is opened, close it and perform tracheotomy. If trachea is opened, insert tube. If wound is above larynx, sew it up, drain, and perform tracheotomy.

Sequelæ to Cut Throat.—Aerial fistula, generally in the thyrohyoid space. Pharyngeal fistula. Laryngeal or tracheal stenosis. Aphonia from injury of larynx or recurrent nerve.

DISEASES OF THE THYROID GLAND.

ATROPHY AND HYPERTROPHY.

Atrophy is found in three conditions:—

SENILE ATROPHY.—When it causes no symptoms.

MYXŒDEMA.—The epithelial tissues disappear partly or entirely, and what remains is only connective tissue.

CRETINISM.—The gland is either: (1) Congenitally absent; (2) Represented by a mere connective-tissue rudiment; or (3) Present as a goitre, with few or no epithelial elements. It may be sporadic or endemic, the latter being common in districts where endemic goitres occur.

Atrophy of the Thyroid Gland, *continued*.

In both myxœdema and cretinism there occur :—

1. **CHANGES IN THE SUBCUTANEOUS TISSUES.**—Great increase of fat and mucoid tissue. The hair is brittle and falls out. Supraclavicular fatty masses are very conspicuous.
2. **CHANGES IN THE NERVOUS SYSTEM.**—Amentia or dementia is prominent. In the case of cretinism a state of childishness or imbecility continues throughout life unless the case is treated.
3. **CHANGES IN THE SKELETON.**—The terminal phalanges become broad and spatulous. In cretinism growth is arrested, so that the stature of the adult is that of a child of about six.
4. **CHANGES IN THE GENITAL ORGANS.**—The cretin has undeveloped sexual glands, undescended testes, and no secondary sexual characters. In myxœdema sexual feeling and power are lost.

TREATMENT.—

FEEDING with dried extract of sheep's thyroid (gr. x daily).

GRAFTING with human thyroid gland. Small pieces are taken from healthy thyroid tissue (e.g. from a patient with a thyroid adenoma) and implanted: (1) Under the skin; (2) Beneath the abdominal muscles; or (3) In the head of the tibia of the patient.

Hypertrophy (apart from parenchymatous goitre) is found in the following :—

1. Of a portion of gland when the rest has been removed.
2. During menstruation (probably merely a hyperplasia), at puberty, during pregnancy, after sexual excitement.

ENLARGEMENTS OF THE THYROID GLAND.**THYROIDITIS.****Varieties.**—

PYOGENIC OR ACUTE INFECTIVE.—Is rare, and commoner in enlarged thyroids. May accompany the exanthemata. Gland becomes swollen, tender, and fixed.

TREATMENT.—Fomentations. Incision.

TUBERCULOUS.—Rare. Usually in young subject. Hard tuberculous masses develop rapidly in the gland. Thyroid becomes fixed, and pressure symptoms may develop.

TREATMENT.—Excision of affected gland.

GUMMATOUS.—Rare, and easily mistaken for malignant thyroid. Gland is nodular and fixed. Pressure symptoms may develop.

TREATMENT.—Antisymphilitic if diagnosed.

LIGNEOUS (*Riedel's Disease of the Thyroid*).—A lymphomatosis, followed by a fibromatosis of the gland. Involves both lobes and isthmus. Perithyroiditis occurs, with fixation of the gland. Pressure symptoms develop.

TREATMENT.—By X-ray therapy, or excision of the isthmus or one lobe.

GOITRE.

SIMPLE OR PARENCHYMATOUS ENLARGEMENT.

In this the enlargement is uniform. It is the common form in young patients, and rarely begins after twenty-five. (*Fig. 117.*)

Stages in Development.—(1) Hypertrophy of the vesicles: goitre is then hard and solid. (2) Colloid stage: excess of colloid distends the vesicles. (3) Colloid cystic stage: vesicles run together and form cysts. (4) Stage of focal hyperplasia or nodular goitre: little islands of foetal adenomatous cells in the interacinous spaces multiply to maintain the function of the gland that is otherwise being destroyed. (5) Degenerative goitre: areas of degeneration, areas of calcification, areas showing hæmorrhage into cysts.

Etiology of Parenchymatous Goitre.—It is usually endemic. The localities most affected are in Switzerland, mountainous districts of France and Italy, Derbyshire and Gloucestershire in England. It is associated with a limestone geological formation, which probably causes some peculiarity of the drinking-water. Possibly this consists in the absence of iodine or iodides.

Physical Signs of Goitre.—

MOBILITY.—The gland moves up and down in swallowing. It cannot be separated laterally from the trachea. This alone usually suffices for the diagnosis, but:—

1. **OTHER CERVICAL SWELLINGS WHICH MOVE ON DEGLUTITION** are: Lymph-glands adherent to the trachea; abscesses or malignant growths connected with larynx, trachea, or œsophagus; subhyoid bursæ; thyroglossal cysts.
2. **GOITRES WHICH DO NOT MOVE WITH DEGLUTITION:** Very large masses which cannot pass through the thoracic inlet. Goitres which are fixed by malignant or inflammatory adhesions.

SHAPE AND SIZE.—Parenchymatous goitres may be horse-shoe-shaped, but others are usually oval. The size is anything up to that of a man's head, in which case it hangs over the sternum.

POSITION.—Usually below the larynx. In the mid-line or lateral. Sometimes substernal; rarely high up on a level with the great hyoid cornu. Pushes the sternomastoid muscle outwards.

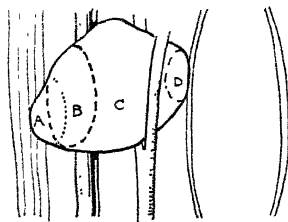


Fig. 116.—Cysts in the neck derived from remains of a branchial cleft. The whole cyst (C) represents the maximum extent, reaching from the sternomastoid muscle to the pharynx. A, Remnant adjoining muscle; B, Cyst between muscle and vessels; D, Cyst adjoining the pharynx.

(After Hamilton Bailey.

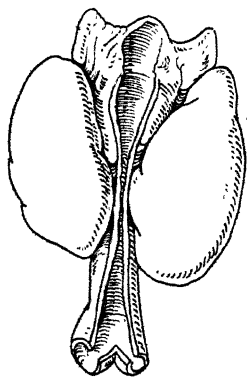


Fig. 117.—Parenchymatous goitre seen from behind. The trachea is shown cut open, and is compressed laterally between the enlarged thyroid lobes.

RELATION TO VESSELS.—The common carotid is pushed backwards and outwards, whilst the internal jugular vein becomes spread over its surface, being tied to it by the thyroid veins. In malignant goitre the vessels become surrounded without much displacement.

RELATION TO THE STERNUM.—Occasionally substernal goitres descend as low as the arch of the aorta.

PULSATION.—Thyroid tumours often present a pulsation, which is either (1) communicated from the carotid, or (2) is that of the thyroid arteries, or (3) is due to the vascular nature of the growth, especially in Graves' disease. A bruit is often heard—loud and rasping—in these cases.

CONSISTENCE.—Soft when parenchymatous. Firm and elastic when adenomatous or cystic. Hard when fibrous or calcified.

PRESSURE EFFECTS.—

ON VEINS.—The jugular veins become engorged, but œdema and cyanosis are seen only in malignant or inflamed growths.

ON NERVES.—The recurrent laryngeal, sympathetic, cervical, and brachial nerves may be involved, in this order of frequency, but marked nerve involvement is a grave sign of malignancy.

ON THE TRACHEA.—This may be (1) displaced laterally, (2) kinked, or (3) compressed laterally, so that its cavity is reduced to a chink. This is the common cause of dyspnoea.

ON THE OESOPHAGUS.—Very rarely a posterior thyroid growth may cause displacement and compression of the gullet.

Dyspnoea.—This is practically the only symptom produced by goitres. It arises in several ways, pressure on the trachea being far the commonest:—

1. **TRACHEAL PRESSURE.**—The trachea is displaced laterally, or sometimes backwards (by a substernal goitre). Its lumen is narrowed by (a) kinking, (b) unilateral pressure, (c) bilateral pressure (*see Fig. 117*). It becomes soft and yielding after long pressure, but not actually atrophied.
2. **BY PRESSURE ON THE RECURRENT LARYNGEAL NERVES.**—This is very rare, as shown by the infrequency of aphonia combined with dyspnoea.
3. **BY EXTENSION OF THE GROWTH INTO THE AIR-PASSAGES.**—This occurs only in malignant disease.
4. **BY RUPTURE OF A CYST OR ABSCESS INTO THE TRACHEA.**
5. **BY CAUSING ŒDEMA GLOTTIDIS.**—Only in inflamed or malignant goitres.
6. **BY SWELLING OF THE MUCOUS MEMBRANE** of the air-passages. This occurs when the patient catches cold or contracts bronchitis.

Goitre—Dyspnœa in, *continued*.

INCIDENCE OF DYSPNŒA IN GOITRE.—It occurs most often in patients between the age of puberty and twenty, in parenchymatous, bilateral, and substernal goitres.

ITS SUDDEN APPEARANCE may be due to hæmorrhage into a cyst, or the rapid enlargement of cystic cavities.

A BRASSY COUGH generally accompanies the dyspnœa, and is due to the tracheal affection.

Treatment of Simple Goitre.—

GENERAL.—Removal of the patient from goitrous district.

Iodine and iodides (tr. iodi ℥v, pot iod. gr. iv, t.d.s.), thyroid extract (gr. v, t.d.s.).

This drug treatment only acts in parenchymatous cases in young patients. It has no effect on cysts or adenomata.

Marked diminution will occur in one month or not at all.

Local applications—iodine and mercuric iodide ointments—may be applied to the goitre, but the effect is very slight.

INDICATIONS FOR OPERATION.—Dyspnœa or other pressure signs, or steady enlargement. Cysts or adenomata. Failure of medicinal treatment in diffuse goitre.

PRECAUTIONS.—Use of local anæsthetic in those cases where dyspnœa is well marked. Intratracheal anæsthesia overcomes all difficulties due to dyspnœa, and by minimizing respiratory movements it gives a very placid operation. Performance of the operation in the position of greatest ease as regards breathing.

OPERATIVE.—

1. HEMITHYROIDECTOMY.—One-half or more of gland is removed in its capsule through a collar incision. Infrahyoid muscles are drawn outwards or cut. Leaves a large unsightly unilateral lobe.

Special care is to be taken of (1) the internal jugular vein, as it lies expanded over the goitre, and (2) the recurrent laryngeal nerve, as it lies behind and in very close connection with the tumour below the cricoid cartilage.

Divide the isthmus and remove the lobe. Drain for twenty-four hours.

2. BILATERAL WEDGE RESECTION.—The operation of choice in diffuse goitre. A large wedge with base anteriorly is cut from each lateral lobe, and the cavity left is obliterated by catgut suture. The isthmus is divided between clamps.

3. ENUCLEATION is the operation for cysts and adenomata, which are shelled out from a capsule formed by thinned gland substance.

ACCIDENTS WHICH MAY OCCUR DURING THYROID OPERATIONS.—

SUDDEN DEATH from dyspnoea occurs in cases where severe dyspnoea is present at the outset. Due to traction on, or pressure on, the trachea, the general anæsthetic, spasm of the glottis, or traction on the nerves in the neck. It is most liable to occur when the tumour is dragged on or turned out of its bed. It is best avoided by local or intratracheal anæsthesia.

PRIMARY HÆMORRHAGE.—This is more likely to be severe in enucleation operations. In extirpation all the chief vessels should be tied before they are cut. It is chiefly venous bleeding that gives trouble.

INJURY OF THE RECURRENT LARYNGEAL NERVE.—Causes unilateral vocal paralysis.

INJURY OF THE SYMPATHETIC OR VAGUS.—The latter may cause death.

INJURY OF THE TRACHEA, PLEURA, ŒSOPHAGUS, OR PHARYNX.

COLLAPSE OF THE FLATTENED TRACHEA.—This is very rare, but may require tracheotomy.

ACCIDENTS WHICH MAY OCCUR AFTER THYROID OPERATIONS.—

RECURRENT HÆMORRHAGE.—Especially after enucleations and if adrenalin solution has been used with a local anæsthetic. It may cause death from hæmorrhage or from dyspnoea. It is a wise precaution to let patient come partly round before sewing up.

SEPSIS, leading to cellulitis or mediastinitis, or to a chronic sinus.

RESTLESSNESS AND RAPIDITY OF PULSE AND RESPIRATION.—This is most often seen in operations for Graves' disease, next in parenchymatous goitres. It is probably due to rapid absorption of thyroid secretion. It is usually fatal. It is best avoided by careful handling of the tumour, free irrigation of the wound with water, and drainage.

LATE VOCAL PARALYSIS, due to involvement of the recurrent nerve in scar tissue.

TETANY.—Very rare. Probably due to removal of the parathyroid glands.

REMOTE COMPLICATIONS.—Only seen after total thyroid removal.

CACHEXIA STRUMIPRIVA.—Symptoms develop two or three months after operation. Fatigue is complained of, and the limbs are heavy and indolent. The hands become swollen and clumsy, and all fine movements impossible. Skin is pale and much swollen, especially over the eyelids, forehead, cheeks, and tongue, but there is no pitting on pressure. The facial expression is dull and vacant. Cerebration is very slow, and memory is bad. Speech is slow and laboured. The skin

Treatment of Simple Goitre—Remote Complications, *continued*

becomes dry and scaly, and the hair falls out. The temperature is subnormal, and there is great sensitiveness to cold. If the patient is immature, growth and sexual development are arrested. In adults sexual functions cease.

TREATMENT.—Administration of thyroid extract, or thyroid grafting.

TOXIC GOITRE.

There are two varieties of this condition: (1) Exophthalmic goitre (Graves' disease); (2) Toxic adenoma. Respective characteristics:

Exophthalmic Goitre.

1. In early life.
2. Symptoms commence within one year of enlargement of gland.
3. After two or three months may improve and later relapse.
4. Exophthalmos almost always present.
5. May be arrested in development by medical treatment. May or may not cause death from tachycardia and failure in the heart muscle action. May pass to hypothyroidism.

Toxic Adenoma.

1. In later life.
2. May be no symptoms for 10 or 12 years after enlargement.
3. Symptoms, once they appear, are always progressive.
4. No exophthalmos.
5. If not removed by operation, death always results from tachycardia, and cardiac muscle failure. Does not yield to medical treatment.

For remaining symptoms see section on EXOPHTHALMIC GOITRE.

Exophthalmic Goitre.—

ETIOLOGY.—Females form 90 per cent of the cases, and the age incidence is the early periods of sexual activity (fifteen to thirty). The local occurrence bears no relation to endemic goitre.

ANATOMY.—The gland is uniformly but not very greatly enlarged. It is of smooth surface and firm fleshy texture. The blood-vessels are neither large nor conspicuous. Microscopically the tissue shows great epithelial proliferation and diminution or absence of colloid material. The thymus gland is often enlarged.

PATHOLOGY.—The disease is due to: (1) Increased thyroid activity; (2) Perverted thyroid activity; (3) Increased absorption of thyroid secretion. Evidence of causative disease of the central nervous system or sympathetic is quite absent.

SYMPTOMS.—

CARDINAL.—(1) Uniform and slight thyroid enlargement; (2) Prominence of the eyeballs, with delay in the descent of the upper lid when shutting the eyes; (3) Tachycardia, with attacks of palpitation.

ACCESSORY.—(4) Nervous symptoms, tremor, excitability, and attacks of acute mania; (5) Sweating, with intolerance of heat; (6) Dyspnoea; (7) Diarrhoea; (8) Glycosuria; (9) Patchy pigmentation; (10) Local fatty swellings, especially on the abdominal wall; (11) Slight elevation of temperature.

INCREASE OF BASAL METABOLISM.—The amount of oxygen used in a given time under resting conditions is measured, and compared with that of a normal individual of the same age, weight, height, and sex. Any variation of over 10 per cent from the normal shows altered metabolism. In exophthalmic goitre the rate is increased from 20 to 60 per cent. The amount of this increase is a good index of the gravity of the disease.

OCCASIONALLY the goitre or the exophthalmos may be absent. The exophthalmos is due to an accumulation of fat in the orbits and to spasm of the unstriated muscle fibres which lie at the back of the eyeball. The dyspnoea is due to cardiovascular changes, and is not accompanied by stridor.

TREATMENT.—

MEDICINAL.—Bromides, digitalis, and belladonna are useful. Lugol's iodine, $\mathbb{M}\text{ij}$ to $\mathbb{M}\text{v}$, is given—usually several courses with increasing doses, at intervals, are necessary. Complete rest is essential.

RADIOTHERAPY.—X rays or radium produce marked reduction in the size of the goitre.

SURGICAL.—

Arterial Ligature.—Both superior and one inferior arteries are tied, and some improvement results.

Subtotal Thyroidectomy.—Removal of about three-quarters of both lobes together with the isthmus. The posterior portion of each lobe is left, so as to save the parathyroids and to avoid the recurrent laryngeal nerves. Gentle handling and meticulous care in hæmostasis are essential. Prior to operation great care must be taken with treatment. Complete rest and quiet. The heart to be fortified by previous treatment, which must be continued after operation. Basal metabolism should approach the normal if possible. The patient should be in a resting phase of the disease. The alarm of the operation should be minimized. This may be done in various ways. Rectal ether with a previous preparation by simple enemata. Twilight sleep, with removal under local anæsthetic, or intratracheal ether. After operation the patient should be treated out of doors, and covered only with a thin sheet till he complains of cold. Morph. hydrochlor. gr. $\frac{1}{4}$ every four hours for first 48 hours.

Toxic Adenoma.—A localized adenomatous growth in one lobe of the thyroid. Usually single and of slow enlargement. Its clinical characteristics are given in the above table.

TREATMENT.—Removal by operation essential, with precautions similar to those taken in exophthalmic goitre.

MALIGNANT DISEASE.

Etiology.—Rarely occurs before forty. Affects both sexes equally. Often develops in a simple goitre.

Structure.—Alveolar carcinoma and sarcoma, either round- or spindle-celled, are of about equal frequency. Sarcoma is rather more likely to form localized swellings of rapid growth, and carcinoma general enlargement of slower growth; but usually the distinction is impossible.

Symptoms and Signs.—Special signs of a goitre being malignant are: (1) Hardness, with bossy outline; (2) Evidence of early nerve involvement—unilateral vocal cord paralysis, shooting pains up the neck and down the arm, contraction of the pupil and palpebral fissure; (3) Involvement of blood-vessels—the carotid, instead of being displaced, is surrounded by the growth, and cyanosis with œdema of the face may occur late in the case from obliteration of the veins; (4) Penetration of the trachea, and much more rarely the pharynx, by the growth; (5) Great fixity to the surrounding structures. The skin and lymph-glands are, however, rarely involved.

Metastasis occurs in the bones and the lungs. In the former case pulsating tumours are formed, especially on the cranial bones. Metastasis sometimes occurs from thyroid tumours which show no other sign of malignancy.

Death occurs in three months to two years.

CAUSES.—(1) Dyspnoea; (2) Penetration of the trachea, with septic pneumonia; (3) Œdema glottidis; (4) Hæmorrhage into the growth, with sudden dyspnoea.

Adenomata and Papilliferous Adenomata.—Adenomata when they become malignant, have only a limited malignancy: that is, they are very liable to recur, but at first do not infiltrate the tissues or cause metastases.

Treatment.—

RADICAL.—Is only possible in a small proportion of cases; often involves resection of the great vessels or trachea. Operative mortality is 35 per cent, and survival for three years only 6 per cent.

PALLIATIVE.—Local removal of masses which compress the trachea.

TRACHEOTOMY.—This is rarely possible below the tumour.

Often it has to be done through the growth. Generally it should be done above the growth, and a long Koenig's tube, 4 to 5 inches long, passed down beyond it.

THE PARATHYROIDS.

These are four small bodies about $\frac{1}{4}$ inch in diameter, arranged in pairs behind the thyroid gland. They are very variable in size, position, and number. If they are removed in thyroid operations, **TETANY**, which is usually fatal, results. This condition is to be treated by calcium and parathyroid extract.

(See also GENERALIZED OSTEITIS FIBROSA, p. 247.)

CHAPTER XXXIV.

DISEASES OF THE AIR-PASSAGES
AND CHEST.

FOREIGN BODIES IN THE AIR-PASSAGES.

In Nasal Passages.—Common in children. Unilateral purulent discharge.

TREATMENT.—Syringing through sound nostril. Removal under an anæsthetic.

At the Rima Glottidis.—Food mass, or large foreign body. Rapid asphyxia and death.

TREATMENT.—Removal by the finger from the mouth, or immediate laryngotomy.

In the Larynx.—Small, round, foreign bodies. Produce urgent dyspnoea; croupy cough. Complete obstruction occurs later from cedema.

TREATMENT.—Remove by laryngeal forceps (suspension laryngoscopy), laryngotomy, or thyrotomy.

In the Trachea.—Attacks of spasmodic cough and dyspnoea caused by the foreign body impacting against the larynx. Tracheitis, with cough and expectoration.

TREATMENT.—Removal through a bronchoscope. Low tracheotomy, with removal; or stitch open the tracheal wound and wait for the foreign body to be coughed up.

In a Bronchus.—Smooth, round, heavy bodies, e.g., marble or intubation tube. Generally into the right bronchus, because: It is more in a line with the trachea; the septum between the bronchi lies to the left of the middle line; the right bronchus is larger than the left in the proportion of five to four.

SYMPTOMS.—Short attack of spasmodic dyspnoea, due to the passage through the larynx. Collapse of the corresponding lung, due to the air escaping more easily than it enters. Produces: (1) Dullness and absence of breath-sounds; (2) Unilateral bronchitis, bronchiectasis; (3) Abscess of the lung, or pneumonia; (4) Empyema.

RESULTS.—Death from one of the above. Expulsion with pus from an abscess by violent coughing. Expulsion with the pus of an empyema.

TREATMENT.—Removal through a bronchoscope; removal through low tracheotomy; removal through posterior chest wall.

LARYNGEAL AFFECTIONS.**Œdema Glottidis, or Œdematous Laryngitis.—****CAUSES.—**

1. DIRECT INJURY of larynx by scalds, corrosives, or wounds.
2. FOREIGN BODY impacted in the larynx.
3. SECONDARY to : (a) Any inflammatory disease of the larynx ;
(b) Cellulitis of the neck (Ludwig's angina) ; (d) Acute glossitis ; (e) Retropharyngeal abscess.

ANATOMY.—Swelling and œdema of : aryteno-epiglottidean folds ; inter-arytenoid fold ; epiglottis, which becomes folded on itself ; false vocal cords. Rima glottidis becomes partially or totally occluded.

SYMPTOMS AND SIGNS.—Intense inspiratory dyspnoea. Epiglottis and folds above the larynx are seen and felt to be swollen, red, and œdematous.

TREATMENT.—

IN SLIGHT CASES.—Scarification of the swollen mucous membrane. Ice compresses externally.

IN BAD CASES.—Tracheotomy.

Syphilis of the Larynx.—

IN THE SECONDARY STAGE.—Mucous tubercles. Superficial ulceration. Producing hoarseness and aphonia.

IN THE TERTIARY STAGE.—Gummatous infiltration, and deep destructive ulceration affecting : (1) The epiglottis, which may be completely destroyed ; (2) The parts above the true vocal cords. Necrosis of cartilages. Perichondritis. Later, laryngeal stenosis.

SYMPTOMS.—Early : hoarseness of the voice, hoarse cough, aphonia. Late : dyspnoea from stenosis.

TREATMENT.—Iodides and mercury. Tracheotomy for stenosis.

Tuberculous Laryngitis.—Primary, or secondary to phthisis. Lupus.

ANATOMY.—Tuberculous infiltration and ulceration of arytenoid elevations, aryteno-epiglottidean folds, and epiglottis.

SYMPTOMS.—Great pain—Hoarseness and cough—Dyspnoea and painful dysphagia.

TREATMENT.—

GENERAL.—Open air in warm climate, and forced feeding. Absolute silence.

LOCAL.—Inhalations of orthoform powder for pain. Curetting the tuberculous deposits after cocaineization, and then rubbing in lactic acid (50 per cent solution).

New Growths of the Larynx.—

PAPILLOMA.—In young subjects—Generally arises from the vocal cords—Causes hoarseness, dyspnoea, or laryngeal spasm.

TREATMENT.—Removal by intralaryngeal cutting forceps.

EPITHELIOMA.—Patients over forty—Begins as a warty growth—Very soon ulcerates and invades neighbouring structures.

SYMPTOMS.—Cough—Blood-stained expectoration—Hoarseness or aphonia—Pain, and often dysphagia.

EXTRINSIC FORM.—At or above the rima glottidis. Rapidly spreads to the tongue and pharynx. Quickly involves the cervical glands.

Treatment.—Total laryngectomy. Prognosis is almost hopeless.

INTRINSIC FORM.—Growing from the vocal cords. Comparatively benign. Does not affect the glands.

Treatment.—Thyrotomy, with local removal.

POST-CRICOID CARCINOMA.—Starts on back of cricoid. Commoner in females. Course similar to extrinsic form.

SURGERY OF THE CHEST.**Injuries and Wounds of the Thorax.—**

CLASSIFICATION.—These are usually divided into (a) **PENETRATING**, and (b) **NON-PENETRATING**; but from a practical point of view it is more important to divide them into (a) **SIMPLE**, i.e., without manifest visceral injury, and (b) **COMPLICATED**, i.e., accompanied by an injury to (i) the heart and pericardium, (ii) the lungs and pleura, (iii) the great vessels. For it is obvious that on the one hand mere contusions may be accompanied by severe visceral injury, especially from the sharp ends of broken ribs, and on the other that a wound may penetrate the lung, passing right through it (e.g., a rifle bullet), without causing any special complications requiring treatment.

SIMPLE WOUNDS AND CONTUSIONS.—

NON-PENETRATING.—If it is clear that there is no perforation of the thoracic wall, the injury requires general treatment appropriate to wounds or fractured ribs.

PENETRATING.—If there is evidence or suspicion that the wall of the thorax is perforated, two precautions are necessary: (1) To avoid probing the depths of the wound, which may do much harm and can do no good; (2) Not to close the wound entirely, but to provide free drainage. Otherwise simple penetrating wounds must be treated on general expectant lines, however strong the *a priori* evidence of visceral wounding may be.

COMPLICATED WOUNDS.—

The following are the chief indications of visceral injury:—

1. **HÆMORRHAGE.**—This is usually *concealed*, and does not emerge from the external wound. Pallor, faintness, and

Wounds of Thorax—Indications of Visceral Injury, *continued*.

rapid pulse are its indications. It is most severe in wounds of the great vessels or heart. In pulmonary wounds it may be shown by hæmoptysis.

2. **CARDIAC EMBARRASSMENT.**—A rapid weak pulse, great precordial pain, usually associated with signs of hæmorrhage, due to heart wounds.
3. **DYSPNŒA.**—This may be caused by mere pleural injuries. More often by rapid effusion of blood or air into the pleura from wounds of the lung.
4. **DULLNESS AT THE BASE OF ONE PLEURAL CAVITY** which shifts on movement and which rapidly increases in extent—an indication of bleeding into the pleura.
5. **TYPANITIC RESONANCE** on one side of the chest from pneumothorax, usually combined with signs of free pleural fluid.
6. **INCREASED PERICARDIAL DULLNESS** from bleeding into the pericardium.
7. **SIGNS OF SURGICAL EMPHYSEMA.**

The above all occur within a few hours of the injury.

8. **SIGNS OF PLEURISY OR EMPYEMA.**

9. **SIGNS OF PERICARDITIS OR SUPPURATION IN MEDIASTINUM.**

These latter develop two or three days after the injury.

THE TREATMENT of these wounds is that described below under the headings of **WOUNDS OF THE LUNGS** and **WOUNDS OF THE HEART**.

Wounds of the Lungs.—

CAUSES.—Contusions—Fractured ribs—Penetrating wounds.

RESULTS.—Contusion or laceration of the lung may cause:—

SEVERE PAIN, SHOCK, AND DYSPNŒA.

HÆMOPTYSIS.—Expectoration of blood-stained mucus or pure blood, with death from asphyxia or syncope.

HÆMOTHORAX.—Rapidly increasing area of dullness, with diminished breath-sounds, without evidences of inflammation.

PNEUMOTHORAX, with pulmonary collapse.—Severe dyspnœa, with tympanitic chest note and amphoric breathing.

HÆMOPNEUMOTHORAX.—As above, but associated with splash-ing sounds.

EMPHYSEMA.—(1) *Surgical*: Due to the air being forced across the pleural cavity, or sucked into an external wound, into the cellular tissue of the parietes. (2) *Interstitial*: Very rare. The air enters the connective tissue of the lung, and may appear in the cellular tissue of the neck.

PLEUROPNEUMONIA, or septic pneumonia.

GANGRENE of the lung.

PLEURISY OR EMPYEMA, especially in cases of penetrating wounds.

TREATMENT OF LUNG WOUNDS.—Absolute rest and recumbency. Avoidance of talking. Firm strapping and bandaging of the chest, unless the dyspnœa is so urgent as to forbid this.

FOR HÆMOPYSIS.—Ergot, adrenalin, sulphuric acid; these all cause contraction of the vessels and raised blood-pressure. Opium and amyl nitrite act by diminishing the blood-pressure.

FOR HÆMOTHORAX AND PNEUMOTHORAX.—Treat by aspiration.

FOR PENETRATING WOUNDS.—Careful treatment of the parietal wound. Examination by X rays to determine foreign bodies or depressed fractures. Intercostal hæmorrhage must be arrested by enlarging the wound and removing part of the rib if necessary. Pulmonary hæmorrhage is usually beyond treatment if severe. In moderate cases it ceases when syncope occurs.

DIRECT SUTURE OF THE LUNG is difficult, because of the great tendency of the lung to retract. The production of a pneumothorax in some cases will in itself serve to check the bleeding, because the vessels share in the general collapse of the lung.

REMOVAL OF FOREIGN BODIES is only to be undertaken :

- (1) If they are causing definite inflammatory symptoms ;
- (2) If the X rays show that they are in an accessible position.

OPERATIONS ON THE LUNGS.—Special differential pressure apparatus is unnecessary. Free opening of one pleural cavity with retraction of the lung is without danger. Incision is made along the 4th rib and cartilage in front, the cartilage is cut by a V-shaped incision, the periosteum is incised, and the rib held out of the way. The pleura is opened, the 3rd and 5th ribs are retracted from one another. The hand is inserted, the foreign body palpated, or the affected part of the lung is brought up into the wound. Removal of projectiles and suture of the lung are performed. The lung is dropped back, the 4th rib is replaced, and the wound sutured.

Tumours of the Lung and Mediastinum.—

INNOCENT.—Commonest are DERMoids and TERATOMAS. Generally originate in mediastinum. May ulcerate into bronchus, and sebaceous matter or hairs may be expectorated.

MALIGNANT.—

SARCOMA.—*Primary* sarcoma very rare.

CARCINOMA.—May be squamous from bronchi or columnar originating in bronchial glands.

Diagnosis.—In early stages difficult. Signs of chronic bronchitis, with consolidation. Prune-juice sputum. X rays show dense shadow.

Treatment.—Almost hopeless owing to lateness of diagnosis. Lobectomy has been attempted.

Chronic Pleural Effusion.—

CAUSES.—Tubercle and heart disease. Other infections almost invariably lead to empyema.

PHYSICAL SIGNS.—Side of the chest moves badly. Massive dullness extending from the base upwards. Diminished breath-sounds and vocal fremitus. An area of ægophony towards the upper level of the fluid. Displacement of the heart to the opposite side, and of the liver and diaphragm downwards.

SYMPTOMS are those of the primary lung condition—dyspnoea, cough, rapid pulse, etc.

SURGICAL TREATMENT.—Aspiration through the 6th inter-space in the mid-axillary line. As much fluid as possible is withdrawn until coughing or bleeding begins.

Empyema.—

CAUSES.—Injuries, wounds, pleuropneumonia, tubercle, abdominal suppuration. Extension from neighbouring abscesses, e.g., liver, kidney, subphrenic, etc.

MICRO-ORGANISMS.—The pneumococcus is far the commonest.

Tubercle is associated with the very chronic cases. Staphylococci and streptococci are fairly frequent.

SIGNS.—The same as those of a serous effusion, but if left to itself, the intercostal spaces begin to bulge, and actual pointing of the abscess occurs usually in one of the upper spaces in front (empyema necessitatis).

SYMPTOMS.—As in the case of an effusion, but a raised or hectic temperature is the rule.

RESULTS.—The lung becomes collapsed, and the visceral pleura then ties it down by becoming thick and contracted. The parietal pleura becomes enormously thick and fibrous. Permanent displacement of the heart and mediastinum, which become dragged over to the diseased side. The opposite lung undergoes some compensatory hypertrophy. The diaphragm and abdominal viscera are displaced upwards. The chest wall falls in somewhat, and the spine is curved with the concavity towards the disease.

PROGNOSIS.—

PNEUMOCOCCAL INFECTIONS run a favourable course without becoming chronic.

PYOGENIC AND TUBERCULOUS CASES usually become chronic, and require resection operations to close the cavity.

STREPTOCOCCAL INFECTIONS have the worst prognosis.

TREATMENT.—If **ASPIRATION** shows that the fluid is pus, then except in small effusions with pneumonia:—

DRAINAGE ought to be performed. First examine specimen of pus. If pneumococcal (adherent), proceed at once to provide drainage. If streptococcal (non-adherent), treat first by

aspiration and then drain. Resect two inches of the 8th or 9th rib in scapular line. Place patient on diseased side, and rather over on his face. Insert large but short tube.

IRRIGATION not often employed, but in chronic cases it may be useful. Use sterile water, with gentle stream and free outflow.

ENCOURAGE THE EXPANSION OF THE LUNG.—This may be done in two ways, which should be adopted as early as possible after the acute symptoms have abated: (1) Application of a Bier's suction glass over the wound for half an hour twice a day; (2) Making the patient blow into two Wolf's bottles containing a quart of fluid. The fluid is driven alternately from one bottle to another, and the increased intrabronchial pressure expands the lung. It is specially suitable for children, who regard this as an amusement.

RESECTION OF RIBS (Estlander's operation).—In chronic cases after the cavity has become permanent. An oblique or flap incision is made over the side. A large piece of all the ribs over the cavity (usually the 3rd to 9th) is removed, or two portions at the anterior and posterior ends are removed so that the middle piece may fall in. As much of the thick pleura as possible is scraped away.

RESECTION OF CHEST WALL (Schede's operation).—A large flap is turned up from the side of the chest, including all the soft parts down to the ribs. The whole of the bony and pleural outer wall of the cavity is removed in one piece. As much of the visceral pleura as possible is dissected off the lung.

Abscess of the Lungs.—

CAUSES.—Pneumonia—Gangrene—A foreign body—Wounds—An infective embolus.

SIGNS.—Are those of local consolidation, with hectic temperature. X rays give a shadow. The abscess may rupture into a bronchus, with the expectoration of a quantity of foul pus. After this there will be the physical signs of a cavity in the lung, with coarse moist bubbling râles and amphoric breathing.

TREATMENT.—Free opening through the chest wall, with excision of a piece of rib. If pleural adhesions are firm, the lung can be opened directly after plunging a probe or sinus forceps into the cavity. Drain with a large tube.

If pleural adhesions do not exist, it is best either to stitch the visceral and parietal pleuræ together, or to pack in some gauze and wait for two or three days.

HYDATID OF THE LUNG is treated in the same way.

Tuberculosis of the Lungs.—Surgical treatment is almost confined to unilateral cases. All methods aim at obliteration of diseased cavities and production of rest. They are:—

1. PRODUCTION OF ARTIFICIAL PNEUMOTHORAX.

Tuberculosis of the Lungs—Surgical Treatment, *continued*.

2. AVULSION OF PHRENIC NERVE.—Results in paralysis of one-half of the diaphragm.
3. APICOLYSIS.—This consists in freeing the apex of the diseased lung, and compressing the lung by the insertion of fat, muscle graft, or gauze tampon.

The Production of an Artificial Pneumothorax.—

INDICATIONS.—Phthisis; in cases where the disease is chiefly unilateral. Some cases of bronchiectasis.

METHOD.—Under local anæsthesia a hollow needle is thrust into the chest. It is attached to a water manometer whose oscillations show when the pleura has been entered. Then up to 200 c.c. of nitrogen are injected slowly and the needle is withdrawn. This is repeated about once a week or at longer intervals.

RESULTS.—In suitable cases, i.e., when there are no pleural adhesions, the lung contracts and the cavities become smaller or are obliterated. The temperature becomes normal and the amount of sputum much less.

DANGERS.—*The production of an excessive pleural reflex* by injecting the gas before the parietal pleura has been punctured, or in cases where there are pleural adhesions which become torn by the pressure. The symptoms are pain and collapse. *Injection into the lung*, causing emphysema, and infecting the pleural cavity. Both these dangers can be avoided by only using the injection when the water manometer proves that the needle is in a free pleural cavity.

Wounds of the Heart.—

CAUSES.—Gunshot wounds. Punctured wounds, usually of a suicidal nature.

SIGNS AND SYMPTOMS.—

1. EXTERNAL SIGNS.—Wound over precordium, with hæmorrhage or emphysema. In cases in which surgical intervention is possible, external bleeding is usually insignificant.
2. HÆMOPERICARDIUM.—The cardiac dullness is increased, the heart-sounds are soft and distant. Venous distension in the neck, cyanosis, blueness of the lips. Marked dyspnoea. Sensation of fear and suffocation.
3. HÆMOTHORAX.—In the worst cases the left lung and pleura are also wounded and the blood rapidly fills the chest, and death soon occurs.

OPERATION.—A large osteoplastic flap is necessary in order to gain room for manipulations. It may be turned outwards or inwards, the former being the better.

The flap must include the 4th, 5th, and 6th ribs and cartilages, and extend from outside the nipple line to the sternum. The costal cartilages are cut close to the sternum and the flap

turned outwards by cutting and breaking the ribs at the outer margin of the flap. This exposes the pericardium over both ventricles and the left auricle. If the right auricle is wounded a part of the sternum must be removed. The left lung and pleura are to be pushed back with gauze pads.

The pericardium is opened, the clots are removed, and the heart wound is sutured. The flap is replaced and the wound drained.

ASPIRATION OF THE PERICARDIUM.—In many cases of the more favourable kind a timely aspiration of the pericardium may ward off the danger of pressure upon the heart until the wound can be dealt with.

METHOD.—The trocar is thrust into the 5th interspace close to the sternum, inwards and backwards, and the blood removed by an aspirator.

RESULTS.—In 120 cases treated by operation, 46 per cent recovered, whereas only 15 per cent of those not operated on survive. In the great majority of cases the wound affects the ventricles, the right and left being about equally involved. The auricles are wounded in about 7 per cent.

CAUSE OF DEATH.—

1. **HÆMORRHAGE.**—When the wound is large, bleeding causes death before anything can be done.
2. **PRESSURE UPON THE HEART.**—The blood collecting in the unyielding pericardium presses upon the heart, and is the cause of death in the cases of moderate severity.
3. **SUPPURATION.**—In nearly 90 per cent of operation cases suppuration occurs in the pericardium or pleura, and is the cause of death in about half these.

Pericardial Effusion.—Seldom requires surgical treatment. Aspiration should be done in the 5th space, $1\frac{1}{2}$ in. from the sternal margin.

Pericardial Suppuration.—May be acute from pyogenic cocci (including the pneumococcus), or chronic from tuberculous infection.

DRAINAGE is required if effusion does not yield to other measures. Drain through costosternal angle.

Direct Massage of Heart as means of Restoring Life.—

In cases where the heart ceases to beat owing to the shock of trauma, operation, anæsthetic, or asphyxia, life may sometimes be restored by direct stimulation of the heart by massage or squeezing movements.

PHYSIOLOGY.—

THE EMPTYING OF A DILATED HEART.—In many of these cases the heart is distended with blood, especially on the right side. If this is expressed the muscle fibres can contract.

404 DISEASES OF AIR-PASSAGES AND CHEST

Massage of the Heart—Physiology, *continued*.

RESTORATION OF CORONARY CIRCULATION.—The vitality of the cardiac muscle is dependent on the circulation in the coronary vessels. Massage will to some extent restore this by emptying the vessels and then allowing them to refill.

RESTORATION OF CARDIAC RHYTHM.—Rhythmical pressure on the heart walls will aid in reviving automatic rhythm of the heart.

METHODS.—

SUBDIAPHRAGMATIC.—A median incision is made into the abdomen through the linea alba just below the ensiform cartilage. The heart is manipulated between the diaphragm and the thoracic wall. This is the easiest, safest method, and has given the largest proportion of successes.

THORACIC.—The pericardium is exposed by an incision or flap through the thoracic wall.

TRANSDIAPHRAGMATIC.—The pericardium is opened through the abdomen and diaphragm. This method has had no success.

ARTIFICIAL RESPIRATION must be carried on steadily irrespective of the heart manipulation.

VENESECTION.—In cases with much asphyxia the withdrawal of about 12 to 20 oz. of blood will greatly relieve the tension in the heart.

RESULTS.—Prospect of success depends upon following factors:—

1. **THE LENGTH OF TIME** during which the heart has ceased to beat. Anything longer than 5 to 10 minutes gives but little chance for restoration.
2. **THE CAUSE OF THE HEART FAILURE.**—Cases due to asphyxia or nerve shock are more likely to recover than those due to the toxic action of an anæsthetic.
3. **THE NATURE OF THE CIRCULATORY FAILURE.**—Cases of congestive asphyxia with cyanosis and venous engorgement give the best outlook. Cases with marked pallor are due to primary cardiac failure and have the worst prognosis. But these are just the cases in which no other means are of any avail, and no time should be lost before the heart massage is begun.

Cardiolysis.—In cases where the heart is hypertrophied and bound down by adhesions to the pericardium, relief may be obtained by removal of the wall of the thorax over the heart. This is termed cardiolysis.

SUITABLE CASES are those in young patients in whom rapid improvement is caused by rest, but in whom the symptoms recur on exertion.

INDICATIONS.—

SIGNS OF ADHERENT PERICARDIUM.—Especially diffuse and forcible cardiac impulse, with retraction of the precordial area on systole.

SIGNS OF CARDIAC FAILURE.—Dyspnoea and oedema when standing or walking. Enlargement of the liver and spleen with ascites from venous congestion.

OPERATION.—A flap containing all the soft parts down to the ribs is turned up from the nipple to the sternum, exposing from the 3rd to the 7th cartilages on the left side. Portions of the 4th and 5th (occasionally from 3rd to 6th) ribs and cartilages are removed, about 3 to 4 inches from each. The posterior costal periosteum is left.

RESULTS.—The force and volume of the pulse are improved. The signs of venous congestion diminish, the liver, spleen, and oedema are lessened. The patient is relieved from distress and can do light work. About 20 cases have been reported without any fatality.

Operation for Pulmonary Embolus.—It has been proposed in post-operative embolism of the pulmonary artery to expose the vessel and remove the clot (Trendelenburg).

METHOD.—An osteoplastic flap containing the 2nd, 3rd, and 4th rib cartilages of the left side is turned back and the pericardium exposed and opened. The artery is incised after the application of special hæmostatic forceps and the clot extracted piecemeal. The vessel is then sutured.

RESULTS.—About eleven successful cases have been reported. In others, death has occurred at the time or shortly afterwards, usually from septic or pulmonary complications.

CHAPTER XXXV.

DISEASES OF THE BREAST.**Ulcers of the Nipple.—**

SIMPLE CRACKS AND FISSURES.—Caused by lactation. Result often in abscess in the breast.

ECZEMA.—

1. Ordinary acute eczema, recovering under treatment.
2. Chronic eczema, with much scaling, but no destruction of the nipple or induration.
3. Paget's disease. A form of chronic eczema. The nipple becomes destroyed. The deep surface of the eczematous patch is hard and indurated. Carcinoma of the underlying breast is associated with it. This is usually regarded as resulting from the nipple condition. But it may be the primary disease and cause destruction of the nipple by destroying and permeating the lymphatics (Handley).

TREATMENT.—First try ointments and lotions for one month if case appears simple. Remove whole breast as for carcinoma if no improvement.

SYPHILIS.—(1) Primary chancre, rare in the mother of a syphilitic child. Axillary glands large and hard. (2) Secondary mucous patches. (3) Tertiary gummata and ulcers, very rare.

EPITHELIOMA.—Crater-like ulcer with hard everted edges. Much destruction of skin and nipple.

SCIRRHUS OR SARCOMA.

INFLAMMATORY DISEASES OF THE BREAST.**Acute Mastitis: Acute Mammary Abscess.—**

CAUSES.—Infection during lactation, either by the ducts or the lymphatics. Pyæmia. Infective parotitis. New-born infants, generally after injury, e.g., 'breaking the nipple-string'. Extension from other structures, e.g., pleura or ribs.

VARIETIES. —

SUPRAMAMMARY.—Abscess forms between the skin and breast.

Treatment.—Simple incision rapidly cures it.

INTRAMAMMARY.—Abscess forms in the breast substance. At first is limited to one or more lobules. It is partly limited by fibrous radiating septa. The whole breast swells because of retained milk.

Treat by free radiating incision; break down septa in the cavity so that no 'pockets' remain. Counter-opening low down for drain.

SUBMAMMARY.—Between breast and chest wall. May arise from rib or chest disease. Breast is pushed forward, but not inflamed.

Treat by opening below and to the outer side.

Chronic Mastitis.—

1. **LOBAR.**—Remains after lactation, from imperfect involution of one or more lobes. Results from injury or an acute mastitis. **SYMPTOMS.**—Pain of neuralgic character. Worse during menstrual period.

DIAGNOSIS from cancer. Flat hand feels no tumour. No craggy edge.

TREATMENT.—Rest. Firm bandage. Belladonna.

2. **LOBULAR OR INTERSTITIAL.**—Women about the menopause. Often in thin and sterile women.

PATHOLOGY.—(a) Overgrowth of interstitial fibrous tissue; (b) Contraction of this fibrous tissue; (c) Consequent pressure on ducts and acini; (d) Epithelial proliferation; (e) Dilatation of acini to form cysts. Cysts are filled with thick, dark, mucoid fluid. There are no intracystic growths.

SIGNS.—Nodular feeling in the whole breast. One or more lumps can be seen and felt. The flat hand often feels nothing against the chest wall. Lymph-glands are often a little large and tender. Nipple may be retracted. Often present in both breasts. Pain is inconstant, and is worse at menstruation. Definite cysts form elastic swellings.

TERMINATIONS.—Atrophy—Polycystic or fibrocystic disease—Carcinoma.

DIAGNOSIS.—From cancer or adenoma.

TREATMENT.—Short period of firm pressure and application of X rays, and then excision if improvement has not occurred.

Chronic Abscess.—Often tuberculous, possibly actinomycotic; either originating in the chest wall. Pyogenic form arises during pregnancy or lactation. Hard but elastic swelling. Centre is softer than the margin.

TREATMENT.—Opening, scraping, and draining.

CYSTS OF THE BREAST.

RETENTION CYSTS.—From the dilatation of acini. Often have serous discharge from nipple.

GALACTOCELE.—Filled with altered milk. Arises during or after lactation.

DISTENSION CYSTS.—

INVOLUTION CYSTS.—Occur in interstitial mastitis blocking the ducts. Caused by contracting fibrous tissue.

IRRITATION CYSTS.—From irritation of nipple, causing reflex secretion.

Cysts of the Breast, *continued*.

INTERACINOUS CYSTS.—

SEROUS CYSTS.—Dilated lymph space. Lined by endothelium.

Never gives rise to discharge from nipple.

HYDATID CYSTS.

TUMOUR CYSTS (*Fig. 118*).—

ADENOMA	} Cysts have intracystic growths, and often	
DUCT PAPILLOMA		a serous or bloody discharge from the
DUCT CARCINOMA		nipple.

CARCINOMA	} From hæmorrhage or degeneration.
SARCOMA	

SIMPLE TUMOURS OF THE BREAST.

VARIETIES.—Fibro-adenoma—Adenoma—Lipoma and chondroma (very rare)—Duct papilloma.

Adenoma Mammæ.—

CONSISTS OF tissue like normal breast-gland tissue.

1. FIRM FIBROUS CAPSULE enclosing—
2. EPITHELIAL ALVEOLI.—Generally in a single layer—Without ducts—Often dilated to form cysts—Cysts often contain intracystic growths.
3. INTERSTITIAL FIBROUS TISSUE.

VARIETIES.—

PURE ADENOMA, or acinous adenoma.—Structure similar to the normal gland.

FIBRO-ADENOMA, or tubular adenoma.—Much the commonest. Fibrous tissue is out of proportion to glandular. Alveoli are drawn out into long canaliculi. A fibrous ingrowth takes place into these canaliculi.

CYSTO-ADENOMA, or serocystic disease.—Alveoli are dilated into cysts. Filled with fibro-papillomatous proliferations. Generally form a large tumour, which may burst through the skin. Often become sarcomatous.

SIGNS.—

AGE.—From puberty to thirty is the time of their origin.

CAUSE.—Often follow a blow.

PAIN.—Neuralgic, worse at menstruation.

TUMOUR.—Hard, oval, and elastic. Freely movable in breast substance. Not fixed to skin, nipple, or chest. Does not produce enlargement of axillary glands. Often multiple and in both breasts. On removal section is hard, white, foliated, and encapsuled. No juice can be scraped from it.

TERMINATIONS.—Remain unaltered. Become carcinomatous or sarcomatous.

TREATMENT.—Removal.

Duct Papilloma.—Small tumour near the surface and near the nipple (*Fig. 118*). An epithelial papilloma growing from the lining

of a duct. A cyst about the size of a cherry, containing a warty growth. Serous or bloodstained discharge from the nipple. Growth is not indurated, and is sharply defined. No enlarged glands.

Becomes a duct carcinoma by the epithelium of the papilloma growing down through the wall of the duct.

TREAT by removal of the breast.

Duct Carcinoma.—Similar to the above, but tumour has an indurated base. Lymph-glands enlarge. Less rapid and malignant than ordinary cancer.

TREAT by removal of the breast.

MALIGNANT DISEASE OF THE BREAST.

Carcinoma.—

VARIETIES.—

SPHEROIDAL-CELLED.—Scirrhus—the common type. Encephaloid.

COLUMNAR-CELLED.—Duct carcinoma.

SQUAMOUS-CELLED.—Epithelioma of nipple.

SCIRRHUS OF THE BREAST.

Etiology.—The proportion of females to males is 100 to 1. More common site for cancer than any other organ except the uterus.

Liability is due to: (1) Rapid structural changes accompanying puberty, lactation, and menopause; (2) Irritation of lactation; (3) Exposure to injury.

May follow: Eczema (Paget's disease)—Mastitis—Adenoma.

Age forty to fifty, at about the menopause.

Course.—Lasts from about one to three years. In old women may be a chronic disease and last fifteen years.

Anatomy of scirrhus mammæ.—Hard mass in the breast, looking like white fibrous tissue. Tumour is generally small and the breast contracted. Craggy edge with no capsule. Cut surface is concave, and yields juice on scraping. It cuts with a grating sensation. Is ill-defined from surrounding structures. It infiltrates breast, connective tissue, muscles, and chest wall, the tissues becoming actually replaced by cancer cells. (*See Fig. 23, p. 73.*)

MICROSCOPICALLY.—Columns of spheroidal cells—the cancer cells. Generally three or four rows of cells in each column. Columns divide and branch irregularly. Quantity of fibrous tissue surrounds the column of epithelial cells.

Mode of Extension.—

1. DIRECT INVASION OF THE ADJACENT STRUCTURES.—

The pectoral fascia, pectoral muscles, skin, chest wall, or pleura may be involved by extension of the primary growth.

Scirrhus of the Breast—Mode of Extension, *continued*.

2. METASTASIS, OR THE EXTENSION TO DISTANT STRUCTURES.*—

PERMEATION OF THE LYMPHATICS, in which the cancer cells grow along the lymph-vessels in direct continuity with the growth, is the mode in which this probably occurs.

PERILYMPHATIC FIBROSIS then takes place on the rupture of those lymph paths which have been first affected, and the cancer cells disappear by this process in the central zone.

THE MICROSCOPICAL GROWING EDGE of the cancer cells can be demonstrated in the lymph-vessels of the deep fascia, disposed like a circle round the primary growth, the diameter of the circle enlarging with the age of the case.

METASTASES occur at any point where the cancer cells have permeated, by a side path or in their direct line of growth, some neighbouring structure, or where perilymphatic fibrosis has failed.

THE LYMPH-GLANDS are naturally the first and most important seat of secondary growth: (a) In the axilla, the pectoral, apical, and subscapular sets are early involved; (b) In the neck, the glands in the posterior triangle are infected by extension from the axillary set; (c) In the mediastinum, the glands may be infected by the lymph-vessels which accompany the perforating branches of the internal mammary, or by extension from the neck.

SKIN NODULES may thus occur in an area which is roughly circular and which has the primary growth as its centre. They never attack the distal parts of the limbs, and are rare except on the trunk, neck, and head.

BONE METASTASIS, too, occurs with a frequency for individual bones which is in proportion to their proximity to the growth, and chiefly at such points as the deltoid insertion on the humerus, or the great trochanter of the femur, where the lymph-vessels of the deep fascia are continuous with the periosteum. The bones most commonly affected are the sternum, clavicle, humerus, ribs, and vertebrae.

TRANS-CÆLOMIC IMPLANTATION is the process by which the cancer cells, when they have reached the pleura or peritoneum, may fall free in these cavities, and cause growths on the surface of the contained viscera.

Symptoms and Signs.—There are always three stages:—

1. STAGE OF EARLY GROWTH WITH DOUBTFUL CHARACTERS.—Hard nodule in the breast, best felt between the flat hand and the chest. Quite painless, and only noticed when washing. No tenderness. Generally in an outlying lobule of the breast. It is incorporated with the gland substance, but at this stage is fixed to nothing else. It steadily increases in size.

* Sampson Handley.

2. STAGE OF ESTABLISHED GROWTH WITH WELL-DEFINED CHARACTERS.—

HARD GROWTH, which has a nodular, craggy, ill-defined margin.

FIXED to the suspensory ligaments, joining it to the skin, producing dimpling.

To the skin itself later on, when it may ulcerate.

To the nipple, dragging on its ducts and producing retraction (*Fig. 119*).

To the pectoral muscle, fixing the breast so that it cannot be moved up and down the length of the muscle fibres (*see Fig. 23, p. 73*).

To the chest wall, so that the breast cannot be moved across the direction of the muscle fibres.

LYMPH-GLANDS form hard, fixed, nodular mass in the axilla and posterior triangle of neck.

PAIN is marked in proportion to fixation. Is neuralgic and intermittent.

SKIN.—May be affected in one of several ways:—

1. Brawny, congested, and fixed to the growth.

2. Ulcerated. Smooth, foul ulcer, whose base is formed by the growth.

3. Nodules of secondary growth over the breast, or at a distance on the skin of any part of the trunk.

4. Cancer *en cuirasse*, the skin forming a layer of cancer-invaded tissue. The 'orange skin' or 'pig skin' often precedes this, the mouths of the glands being opened and large with excess of secretion.

5. Cancerous lymphangitis. The lymph-vessels are filled with cancer cells, and lymph exudes from the lymph capillaries, giving an appearance of weeping eczema.

DISCHARGE—from nipple—blood-stained—is only occasionally present.

3. STAGE OF CACHEXIA.—Rapid emaciation. Marked anæmia.

Skin becomes loose and inelastic all over the body. Growth is densely fixed or widely ulcerated. Lymph-glands by pressure on the vessels and nerves cause cedema and pain in the arm. The solid brawny cedema may be due to the wide destruction of lymphatics by perilymphatic fibrosis. Pleurisy or ascites may occur from metastatic growths. Pain constant and unbearable.

Diagnosis.—In Stage 1 the diagnosis is always conjectural until the growth is under the microscope; but until proved innocent every doubtful tumour should be regarded as malignant.

FROM MASTITIS.—In this the flat hand against the breast can define no tumour. The development is after a blow or lactation. The edge is not hard or craggy. Generally tender. There may be retraction of skin and nipple and enlargement of the lymph-glands.

Scirrhus of the Breast—Diagnosis, *continued*.

FROM FIBRO-ADENOMA.—In this the tumour floats about in the breast substance. Begins before thirty, generally about twenty. It gives pain of shooting kind, worse at menstruation. Very definite outline.

FROM A CYST.—In this there may be other signs of mastitis. Swelling is elastic or fluctuating. History is a long one.

FROM A CHRONIC ABSCESS OR TUBERCULOUS FOCUS.—In this the history is a long one. Pain or tenderness are early. Centre of swelling is softer than the margins.

FROM SWELLINGS OF THE CHEST WALL, e.g., tubercle or actinomycosis of chest wall, aneurysm, etc. These are obviously fixed to the chest, whilst the breast moves over them.

ENCEPHALOID CARCINOMA.

Differs from scirrhus in the following points:—

Anatomy.—Cancer cells are larger. Columns of cancer cells are thicker. Interstitial fibrous tissue is scanty. Growth is large, soft, and vascular.

Etiology.—Occurs in young women, twenty-five to thirty-five. Often follows lactation or pregnancy.

Course.—Very rapid, ending in about six months.

Signs.—Soft or elastic tumour of some size. Very rapid growth. Often feels hot from its vascularity. Is painful in its early stages. Lymph-glands are affected rapidly. Skin is broken through by a fungating mass. Retraction of skin and nipple are absent.

Treatment.—Preliminary treatment by radiotherapy will frequently reduce the tumour in size and make it more amenable to radical treatment.

Diagnosis is never long in doubt.—

FROM ACUTE MASTITIS.—In this an abscess forms, upon opening which the swelling and signs subside. All the signs of inflammation. High temperature.

FROM SARCOMA.—In this the tumour is round and circumscribed. Pain is absent. Lymph-glands are not involved early.

OTHER VARIETIES OF CARCINOMA MAMMÆ.

Atrophic Scirrhus.—Women over sixty. Very slow in course, lasting ten to fifteen years. Great excess of fibrous tissue. Very scanty cancer cells. Produces atrophy of breast.

Colloid Carcinoma.—A degeneration of any spheroidal-celled carcinoma. Cancer cells become colloidal.

MICROSCOPICALLY an irregular network of interstitial tissue contains a few degenerate cells and large clear spaces where the colloid takes no stain.

SIGNS.—Enlargement more rapid. Softer character. Does not lessen the rapidity of the disease.

Acute Cancer or Lactation Carcinoma.—Even more acute than the encephaloid type. May be mistaken for acute mastitis. Differentiated by absence of pain. Treatment is hopeless. Ends fatally in six weeks to three months.

SARCOMA MAMMÆ.

Varieties.—

ROUND-CELLED.—Like lymph tissue. Very rapid. Many metastases, especially in lungs. Lymph-glands seldom involved.

SPINDLE-CELLED.—The common variety. Cells are oat-shaped. Slower in growth. Definitely encapsuled at first.

Etiology.—Any age, without reference to functional changes. Old women and young are often subject to it. No relation to lactation. May follow fibro- or cysto-adenoma.

Signs.—

TUMOUR is elastic or semi-fluctuating. Round and well defined. Very rapid growth.

SPREAD.—Skin is first involved. A fungating, bleeding mass protrudes. Deep tissues are invaded later.

METASTASES.—Lymph-glands, especially in spindle variety. Lungs and pleura.

DEGENERATIONS.—Hæmorrhage—Spurious cysts—Myxomatous degeneration.

TREATMENT OF MALIGNANT DISEASE OF BREAST.

1. RADICAL REMOVAL always involves :—

- a. Removal of whole gland with a good margin.
- b. Removal of wide area of skin over breast.
- c. Removal of pectoral fascia : better with the sternocostal part of muscle.
- d. Removal of whole of axillary glands, pectoral, subscapular, and apical groups.

Occasionally : removal of pectoralis minor in order to clear glands higher ; removal of supraclavicular glands.

SPECIAL POINTS.—

Cases of doubtful diagnosis : excise tumour, and microscope, without waiting for typical signs.

Cases where much skin is removed : (a) Undercutting edges of skin ; (b) Cutting skin flaps ; (c) Thiersch's skin-grafting.

Malignant Disease of Breast—Treatment, *continued*.

2. CASES UNSUITED FOR RADICAL OPERATION.—

Skin conditions: Cancer *en cuirasse*—Widely diffused nodules of cancer—Cancerous lymphangitis.

Adhesions to chest wall.

Lymph-glands causing œdema of arm, or forming a mass in posterior triangle of neck.

Metastases: Pleura, peritoneum, or bones.

Cachexia, with rapid wasting.

3. METHODS OF TREATMENT FOR INOPERABLE CASES.—

Radium needles or radon seeds.

Injections of lead selenide for cancer; Coley's fluid for sarcoma.

X-ray treatment: For recurrent nodules in the skin. Lessens pain and fixation. Lengthens life.

For the brawny œdema of arm: Insertion of subcutaneous silk threads from wrist to chest. Act as capillary drains (Sampson Handley).



Fig. 118.—Cysts in the breast.
A, A duct papilloma.

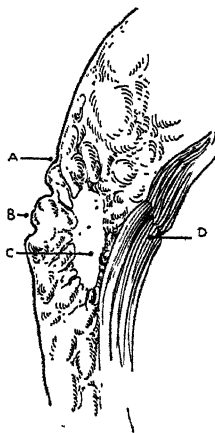


Fig. 119.—Early scirrhous carcinoma of breast. A, Skin drawn in by contracting bands of the growth; B, Retracted nipple; C, Growth; D, Pectoral muscle (not affected).

CHAPTER XXXVI.

INJURIES OF THE ABDOMEN.
PERITONITIS.

CONTUSIONS OF THE ABDOMEN.

Results.—

PARIETAL.—Contusion of abdominal wall—Abscess in the abdominal wall—Rupture of abdominal muscle—Subsequent hernia—Rupture of parietal peritoneum—Bleeding from vessel in parietes, from vessel in abdomen.

VISCERAL.—

RUPTURE OR CONTUSION OF VISCERA.—Liver—Spleen—Kidney—Pancreas—Bladder—Stomach—Intestine—Pregnant uterus—Ovarian cyst.

PERITONITIS, OR PERITONEAL EXTRAVASATION of stomach or bowel contents—Gas—Blood—Urine—Pancreatic juice.

Symptoms.—

FIRST STAGE: SHOCK.—Pallor, sweating, thirst, subnormal temperature, faintness, rapid weak pulse. Evidence of local injury.

SECOND STAGE: RECOVERY FROM SHOCK.—Pulse and temperature may be normal and general symptoms absent, yet severe visceral lesions may be present. If present, third stage soon follows.

THIRD STAGE: ONSET OF COMPLICATIONS.—

1. **FROM INJURY OF SOLID VISCUS.**—Liver, spleen, kidney, pancreas. Symptoms are due to internal hæmorrhage. These are: gradually increasing pulse-rate, also becoming weaker, and all symptoms given under shock above, but in addition restlessness and increased respiration, which may be sighing. These latter two symptoms are important in differentiating internal hæmorrhage from pure shock. The abdomen becomes distended, and there is shifting dullness in the flanks.
2. **FROM INJURY OF HOLLOW VISCUS.**—Stomach or intestines. Resulting symptoms are those of peritonitis. Persistent vomiting, rising pulse-rate, distension of abdomen by tympanites, loss of liver dullness. Increasing tenderness and rigidity of abdominal wall.
3. **FROM INJURY TO BLADDER.**—Inability to micturate, or passage of small quantities of blood and urine. There is often shifting dullness, and later the above signs of peritonitis.

Contusions of the Abdomen, *continued*.

Diagnosis.—Early diagnosis is usually difficult, though essential for successful treatment. If visceral injury is suspected, withhold morphia and food by mouth, give rest and warmth, take the pulse every hour, and if, after recovery from initial shock, the pulse-rate rises and any of above symptoms increase, treat as for visceral injury.

Treatment of Visceral Injury.—Immediate exploratory laparotomy, dealing with such injury as is found. Consider need for blood transfusion and special anæsthesia such as local, spinal, or gas and oxygen.

WOUNDS OF THE ABDOMEN.*

NON-PENETRATING.—This character can only be properly ascertained by carefully excising the wound as a whole down to its bottom. If the peritoneum is uninjured, the other layers are sutured seriatim. Blind probing should always be avoided, as liable to cause penetration and sepsis.

SMALL PENETRATING WOUNDS, e.g., stabs, etc.—The escape of blood, fæces, gas, bile, or urine will establish the fact of visceral penetration. Later there will be signs of peritonitis, but all these may be absent; the wound should nevertheless be opened up without delay and the underlying viscera examined before infection has had time to be established.

MULTIPLE WOUNDS.—Here a median incision is usually necessary to deal with the visceral injuries, whilst the wounds are excised and separately closed.

LARGE WOUNDS.—In these there is great intestinal protrusion. The protruded viscera and the abdominal wall must be carefully cleansed before reduction. Close the parietal wound in at least three layers.

GUNSHOT WOUNDS.—Gunshot wounds ought always to be operated upon. If penetration is doubtful, the X rays and opening the track of the bullet will determine this point. If penetration is obvious, and especially if there are multiple wounds, a large median incision is required, and the viscera must be systematically examined and sutured where necessary.

PERITONITIS.

Causes.—

1. FROM WITHOUT.—Penetrating wounds—Puerperal peritonitis.
2. FROM STOMACH OR INTESTINES.—Injury, ulcer, or perforation.
3. FROM FALLOPIAN TUBES.—Gonococcal—Pneumococcal.
4. FROM BLOOD.—Tuberculous—Staphylococcal—Streptococcal—Pneumococcal.

* Lejars, *Urgent Surgery*, English edition, John Wright and Sons Ltd., 1923, p. 218.

Bacteriology.—

STAPHYLOCOCCUS ALBUS is commonest and least virulent.

Escapes first through injured gut wall in any inflammatory or strangulated condition. Produces phagocytosis and adhesions.

Limits spread of peritonitis from other organisms.

STAPHYLOCOCCUS AUREUS.—Rare, and much more virulent.

STREPTOCOCCUS PYOGENES.—Generally from wounds, also from intestine. Very fatal.

BACILLUS COLI.—Almost always present. Generally from intestine. Pure infection is nearly always fatal. Mixed with *S. albus*, as it generally is, it is not nearly so fatal.

BACILLUS PYOCYANEUS is rarely found as a pure infection, and is then almost invariably fatal.

PNEUMOCOCCUS.—Generally a blood infection associated with pneumonia. Widely diffused. Thin pus. Much fibrin.

TUBERCLE.—Either from intestinal ulceration or blood infection.

ACUTE GENERAL PERITONITIS.**Anatomy.—**

DILATATION OF VESSELS lying beneath peritoneum. Best seen in the coils of intestine.

EXUDATION of lymph upon peritoneal surface, which becomes sticky. This is seen first in the angles between adjacent coils of intestine. Exudation of serum and leucocytes and bacteria, to form purulent exudate. This falls into the most dependent parts—loins and pelvis.

SMALL ROUND-CELLED EXUDATION beneath the peritoneum

ENDOTHELIUM IS SHED in virulent infections. In this case, if recovery occurs, the lymph is organized by the round-celled layer, and forms permanent fibrous adhesions.

If the endothelium is not shed and recovery occurs, the lymph adhesions are absorbed.

ADHESIONS.—First lymph, and later organized granulation tissue (*see above*), mat together adjacent viscera. The omentum especially adheres to the focus of greatest inflammation.

Symptoms.—

GENERAL.—Profound collapse—Drawn face—Small, rapid, wiry pulse—Quick and shallow respirations—Temperature variable, low in worst cases—Vomiting (little force, dark or faecal)—Hiccough—Constipation.

LOCAL.—Extreme tenderness—Rigidity of the abdomen very marked—Pain local and then diffuse—Breathing purely thoracic—Tympanites—Legs drawn up—Dullness in flanks after two or three days.

Note.—In post-operative peritonitis none of the above classical symptoms may be present except general deterioration in patient's condition and quickening pulse.

Acute General Peritonitis, *continued*.

Treatment.—

GENERAL.—Rest and hot fomentations. The lower bowel should be cleared by a simple or turpentine enema, but it is useless to repeat this. The stomach should be washed out at regular intervals, and this is best done by keeping a Rehfuß tube in the stomach if possible. Avoid purgatives. Morphia will almost certainly have to be given for pain. If marked distension exists, the relief of this is imperative. It is doubtful whether drugs such as eserine or pituitrin are of any use, and purgatives are definitely bad. The choice lies between drugs like atropine which inhibit the contraction of the ileocaecal sphincter, spinal injection of novocain which abolishes the sympathetic inhibition of the bowel, and an appendicostomy.

CONTINUOUS SALINE INFUSION.—Given either (1) by rectum, (2) stump of the appendix after the abdomen has been opened, or (3) subcutaneously.

HYPERTONIC SALINE BY INTRAVENOUS INJECTION.—Of great value because it makes good the chloride deficiency which has resulted from the vomiting.

ANTI-GAS-GANGRENE SERUM (*B. Welchii*).—Give 20, to 30 c.c. intravenously. This helps to control the toxæmia, which is probably due to anaerobic organisms in the distended and paralysed gut.

HUMAN OR OX BILE.—Administered per rectum this relieves the incessant vomiting associated with general peritonitis.

OPERATIVE.—

OPEN ABDOMEN: over seat of injury if known; in mid-line if not known.

SEEK CAUSE of peritonitis and deal with it.

EMPTY ALL FREE FLUID by sponging, and manipulate the peritoneal surfaces as little as possible.

DO NOT IRRIGATE if a local peritonitis only is present, e.g., in the great majority of cases of appendicitis, because this would only serve to diffuse infective material.

IRRIGATE with normal saline at 105° F. if adhesions are absent and peritonitis is general.

DRAIN with tubes and wick if pus or faeces are present: (1) Local lesion; (2) Douglas's pouch; (3) Loins.

LOCAL PERITONITIS.

Cause.—Abdominal injury, or visceral injuries, with infection of low degree of virulence.

Varieties.—Abdominal contusion—Subphrenic abscess (*see* p. 422)
—Leaking gastric ulcer or carcinoma—Cholecystitis, or leaking gall-bladder—Duodenal or other intestinal ulcer—Appendicitis—Pelvic peritonitis—Inflammation of ovarian tumour or of uterine appendages—Inflammation of appendices epiploicae.

Symptoms.—

1. LOCAL PAIN AND TENDERNESS.—Symptoms referable to organ involved, e.g., dyspepsia, jaundice, uterine discharge.
2. LOCAL SWELLING.—Induration. Dullness to percussion. Increase of visceral symptoms.
3. SIGNS OF LOCAL ABSCESS.—Raised and remittent temperature. Fluctuating or oedematous swelling. Abscess bursting internally or externally.

Treatment.—First, rest and hot fomentations. When diagnosis is established, operate—Remove cause.

PNEUMOCOCCAL PERITONITIS.*

Primary or secondary. Much commoner in children than adults.

Primary Form.—Either a blood infection or else an infection through the Fallopian tubes. In support of the latter theory: It is rarely found except in dirty ill-cared-for children; it is almost confined to the female sex; pus shows specific organisms.

CHARACTERISTICS.—A very acute form of peritonitis which runs to a fatal course within two to seven days, if not treated.

Diarrhoea, vomiting, and painful micturition are all marked as early symptoms. The signs begin as rigidity of lower abdomen.

Secondary Form.—Occurs with equal frequency in both sexes in association with pneumonia. It affects the whole peritoneum uniformly. It is often overlooked by reason of the existence of the chest condition.

Treatment.—Early laparotomy with evacuation of the thin sero-purulent exudate and drainage.

Transfusion of citrated blood from a relative is a powerful adjuvant to recovery.

CHRONIC PERITONITIS.

Causes and Varieties.—(1) Simple irritation, or septic infection of a mild type; (2) Tubercle; (3) Malignant disease.

Simple Chronic Peritonitis is of two different types:—

1. LOCAL FIBROUS PERITONITIS.—The result of septic invasion which has been of a mild character. It may accompany, or remain after, any acute local infection, and is therefore common round gall-bladder, stomach, appendix, or uterine appendages.
2. SIMPLE PERITONITIS OF UNKNOWN ORIGIN.—In rare instances general chronic peritonitis arises, with effusion and thickening of the peritoneum, but with no clear evidence of its cause. Its association with RHEUMATIC FEVER and BRIGHT'S DISEASE suggests that it is toxic in origin. The peritoneum, especially over the liver and in the great omentum, becomes much thickened and distorted, and there is a marked ascites.

* Fraser and Macartney, *British Journal of Surgery*, April, 1922.

Tuberculous Peritonitis is most commonly found in children and young adults.

ORIGIN.—

1. As a diffuse miliary invasion of the peritoneum, the tubercles occurring in the course of the blood-vessels.
2. From the intestine, either appendix, ileum, or cæcum, and other parts more rarely. In this case the lymph tissue of the gut becomes infected, and thence the disease spreads to the peritoneum.
3. From the uterine appendages: this being one of the commonest modes of origin in women.
4. From tuberculous glands in the mesentery.

VARIETIES.—(1) Ascitic; (2) Fibrous; (3) Suppurative, or ulcerous.

THE ASCITIC VARIETY.—This is, perhaps, the commonest, and certainly the most mild variety.

SIGNS.—The usual signs of distension with free fluid are present. There is a little thickening of the peritoneum and mesentery, but adhesions are absent. The fluid is straw-coloured, highly albuminous, and contains many leucocytes.

TREATMENT by: (1) Constitutional and local remedies, among the latter being the application of iodine or mercury ointments. (2) Laparotomy without irrigation or drainage. The beneficent effect is probably due to the outpouring of serum, containing antibodies, after the removal of the fluid. It cures about 70 per cent of the cases.

THE FIBROUS VARIETY.—

ANATOMY.—There is marked thickening of the mesentery and omentum, the latter often being rolled up as a dense band below the colon. Adhesions form by which the intestines become matted together, especially round the primary focus of disease. Contraction of the mesentery also tends to produce kinking and, together with the adhesions, may cause intestinal obstruction.

THE PHYSICAL SIGNS are those of some free fluid, and also irregular masses can be felt in the abdomen in the situation of the groups of adhesions. The lymph-glands in the mesentery and behind the peritoneum are notably enlarged.

THE TREATMENT is usually only constitutional; the result of operations being as a rule very bad, owing to the ready way in which the diseased intestine is torn, and the impossibility of removing the affected tissues.

THE SUPPURATIVE OR ULCEROUS VARIETY.—

ANATOMY.—This is a further development of the last variety. In the midst of the masses of adherent gut and omentum, foci of caseation and suppuration occur. It is common round the tuberculous uterine appendages. The bowel itself is often the seat of advanced tuberculous ulceration. Secondary

infection of any such suppurating foci by the intestinal bacteria is common.

PHYSICAL SIGNS are similar to the last case ; but localized fluctuating swellings may make their appearance, or break through the parietes, especially at the navel.

TREATMENT is by laparotomy when constitutional treatment has failed. An attempt should be made to remove the primary focus of the disease when this is in the Fallopian tube, appendix, or lymph-glands. There is a grave risk of wounding the bowel and leaving a faecal fistula.

SYMPTOMS.—These are as insidious and ill-defined as in the case of tuberculous lesions elsewhere. Some hectic fever is present in acute or late cases. Emaciation, loss of appetite, and indefinite abdominal pain. Intestinal obstruction is common in the adhesive and suppurative types.

Malignant Peritonitis.—

CAUSES.—

1. Primary malignant disease of the peritoneum. This is an endothelioma, and begins as a rule in the pelvis.
2. Secondary deposits from papilliferous cysts, especially those growing from the hilum of the ovary. These burst through the capsule of the primary growth and become implanted all over the peritoneal surface.
3. Deposits secondary to visceral carcinoma, especially of the stomach, liver, and intestine.

PHYSICAL SIGNS.—Pain, emaciation, and the presence of some tumour, precede the collection of free abdominal fluid.

THE FLUID WITHDRAWN is usually blood-stained, but in the case of the ovarian papilliferous cysts it is thick and mucoid.

CHRONIC PERITONEAL EFFUSIONS : ASCITES.

CAUSES.—

1. Chronic peritonitis, tubercle, new growth, etc.
2. Cardiac and renal disease.
3. Portal obstruction. Cirrhosis of the liver. Malignant disease in the liver or portal glands.

PHYSICAL SIGNS.—

BARREL-SHAPED DISTENSION OF THE ABDOMEN, the skin becoming shiny and marked by 'striae'.

PERCUSSION shows areas of dullness in the flanks during recumbency, in the hypogastrium in the erect posture, or all over if distention is so great that the mesentery is too short to allow the gut to float against the parietes. In typical cases the areas of dullness become resonant when the patient turns over.

FLUID THRILL is felt on one side of the abdomen when the other is percussed : distinct in proportion to the tension of the fluid.

THE FLUID derived by tapping is clear and almost colourless, and contains little albumin and few blood-cells in the obstructive cases as compared with the inflammatory or malignant.

Ascites, continued.

ANATOMICAL VARIETIES.—

1. **DIFFUSE.**—In this, by far the commoner variety, the fluid occupies the great sac of the peritoneum.
2. **LOCALIZED.**—(a) In the lesser sac. Often arising from pancreatic disease, and giving the signs of pancreatic cyst. (b) In the pelvis, especially in women, when it resembles a retroperitoneal or broad ligament cyst. (c) In the omentum or mesentery, when it resembles a mesenteric cyst.

TREATMENT.—

TAPPING by a trocar and cannula over a dull area. This is done most effectively and with least discomfort to the patient by Southey's capillary tubes, one being introduced into each flank, and allowed to drain for several hours.

EPIPOPEXY, or TALMA'S OPERATION, is suitable only for cases arising from portal obstruction. The great omentum is sewn into the parietal wound, and serves to form a new anastomosis between the portal and systemic veins.

MORISON'S OPERATION.—The liver is scarified and sewn to the under surface of the diaphragm.

PERMANENT DRAINAGE.—A small silver cannula or a wisp of silk threads is passed through the femoral canal so as to drain the ascitic fluid from the abdomen into the cellular tissue of Scarpa's triangle and the abdominal wall.

SUBPHRENIC ABSCESS.*

Definition.—A localized collection of pus in contact with the under surface of the diaphragm.

Anatomical Division.—The peritoneum is reflected from the upper surface of the liver on to the diaphragm in a cruciform manner at the coronary, falciform, and lateral ligaments. This affords a simple classification:—

1. **Intraperitoneal**—right anterior, right posterior, left anterior, left posterior.
2. **Extraperitoneal**—right, left.

Etiology.—The greatest number occur between twenty and thirty, the sexes being equal. The causes are septic infection from a neighbouring viscus, or very rarely traumatism.

RUPTURED GASTRIC AND DUODENAL ULCERS cause about one-third or more.

APPENDICITIS and HEPATIC DISEASE cause one-sixth each.

The remaining third of the cases are distributed among the following: Parturition, pyæmia, splenic infarct, thoracic disease, gastric cancer, disease of the lumbar vertebræ, cholangitis, suppurating gall-bladder, suppuration of the right kidney, stabs or crushes of the upper abdomen.

* Barnard, *Brit. Med. Jour.*, 1908, vol. i, 371, 429.

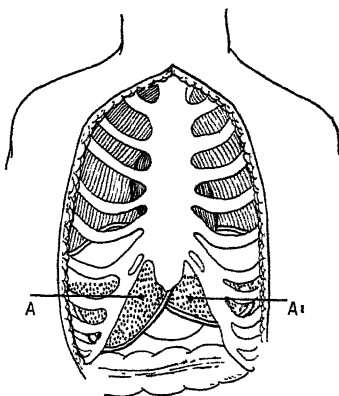


Fig. 120.—Composite diagram of a subphrenic abscess. A, Right-sided abscess; A', Left-sided abscess.

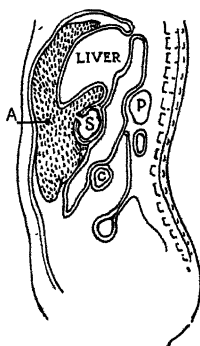


Fig. 121.—Diagram of anterior type of subphrenic abscess: median vertical section. A, Abscess; C, Colon; P, Pancreas; S, Stomach, with perforation on its anterior wall.

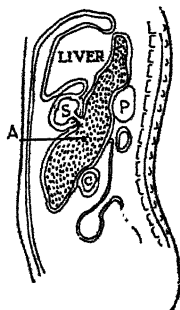


Fig. 122.—Diagram of posterior type of subphrenic abscess. A, Abscess in the lesser sac of peritoneum; C, Colon; P, Pancreas; S, Stomach, perforated on its posterior wall.

Subphrenic Abscess, *continued*.

Pathology.—The process consists of either : (1) A local peritonitis, which spreads from a neighbouring viscus by contiguity or gravitation, or by the lymph-stream towards the diaphragm ; (2) A cellulitis which extends beneath the peritoneum from the liver or cellular tissue of the loins.

THE BACTERIA are the *B. coli* and staphylococci in most cases.

Description of the Varieties (*Figs. 120, 121, 122*).—

1. **RIGHT ANTERIOR INTRAPERITONEAL ABSCESS.**—Over one-third of all cases. Between the right lobe of the liver and the diaphragm, in front of the right coronary and to the right of the falciform ligaments. It spreads down into the loin and below the liver, so that in the majority of cases more than one fossa is involved.

CAUSES.—Appendicitis, liver and gall-bladder suppuration, gastric and duodenal ulcers, are the commonest, and occur in this order. The liver becomes adherent to the anterior parietes, and therefore does not become displaced.

SIGNS.—The abscess forms between the right lobe of the liver and diaphragm, pushing the latter up and causing signs of consolidation at the base of the right lung ; or in gastric cases it forms a tympanitic swelling in the right hypochondrium, bounded by the falciform ligament mesially and a line between the navel and right costal margin below.

2. **RIGHT POSTERIOR INTRAPERITONEAL ABSCESS.**—About one-eighth of the cases. Is between the right kidney and right lobe of liver behind right coronary ligament ; is nearly always associated with the right anterior form of abscess.

CAUSES.—Appendicitis in the great majority.

SIGNS.—An abscess extending below the right costal margin towards the right iliac fossa.

3. **LEFT ANTERIOR INTRAPERITONEAL ABSCESS.**—Forms about half the cases. Lies between the diaphragm above, the left lobe of the liver and stomach behind, the adhesions between omentum and parietes below, the spleen to the left, and the falciform ligament to the right. Usually simple.

CAUSES.—Gastric ulcer in the majority.

SIGNS.—An epigastric swelling, bounded by the mid-line and a line from the navel to the left costal margin, in which gas forms a movable area of tympanites.

4. **LEFT POSTERIOR INTRAPERITONEAL ABSCESS** is the rarest of all varieties (4 per cent). It is contained in the lesser peritoneal sac, having the liver above, the transverse mesocolon below, the stomach in front, and the pancreas behind.

CAUSES.—Posterior gastric ulcers. Disease of the pancreas and bile-duct.

SIGNS are very obscure, being those of a swelling behind the stomach having the relations of a pancreatic cyst.

5. **RIGHT EXTRAPERITONEAL ABSCESS.**—Forms about quarter of cases. It forms between layers of right coronary ligament above back of liver, and pushes liver down towards abdomen. The space in which it forms is continuous in front with that between the layers of the falciform ligament, and behind with the retroperitoneal cellular tissue round the right kidney.
CAUSES.—Hepatic and biliary suppuration in the majority of cases. Suppuration of the right kidney or head of pancreas, duodenal ulcer, and thoracic suppuration rarely.
SIGNS.—Consolidation at the right base, with marked downward displacement of the liver. The abscess may point in the epigastrium or in the right loin.
6. **LEFT EXTRAPERITONEAL ABSCESS.**—A rare variety (5 per cent). It forms between the layers of the left coronary ligament.
CAUSES.—Suppuration of left kidney. Posterior gastric ulcer. Disease of the lumbar vertebræ. Left empyema.
SIGNS.—Consolidation at the left base, with an abscess pointing in the left loin.

Symptoms.—

HISTORY of previous symptoms, of dyspepsia, or liver disease is given in most cases, but the appendix cases usually are of acute origin without previous attacks.

ONSET is sudden in more than half the cases, including nearly all the intraperitoneal varieties. It is insidious in rather less than half, including all the extraperitoneal cases.

PAIN is situated over the site of the abscess, and is acute and stabbing in acute cases, dull and aching in the insidious ones. Vomiting, hæmatemesis, and melæna are due, when they occur, to the causative gastric or duodenal ulcer.

Diarrhœa follows temporary constipation.

Pyrexia, with all its constitutional signs: complexion, tongue, sweating, etc.

Rigors are exceptional and of very ill omen.

Leucocytosis is constant and well marked.

Signs.—

ABDOMINAL.—An abdominal **EPIGASTRIC** OR **HYPOCHONDRIAC SWELLING** is found in two-thirds of all cases. In the majority of these it is formed by an intraperitoneal abscess; in the rest by the liver pushed down by an extraperitoneal abscess. The swelling does not move on respiration, because it is fixed by adhesions.

A **TYMPANITIC AREA** which moves with the patient's posture forms in front of the abscess in many cases.

TENDERNESS AND **RIGIDITY** are well marked over hepatic area.

THORACIC.—**DULLNESS** AT ONE OR BOTH LUNG BASES, with diminished breath-sounds, due to consolidation or compression of the lung, with or without pleurisy, friction sounds being heard in the former case.

AMPHORIC BREATHING AND **TYMPANITES** are found when there is a pyopneumothorax.

Subphrenic Abscess—Signs, *continued*.

THE HEART may be displaced upwards, lateral displacement being much more characteristic of pleurisy.

THE ABSCESS MAY POINT either in the hypochondrium or, more rarely, in the epigastrium or loin.

THE ABSCESS MAY BURST into : (1) The stomach ; (2) Pleura ; (3) Bronchus ; (4) Peritoneum ; (5) Intestine ; (6) Externally. When this occurs into a viscus or mucous canal it often leads to cure, but into a serous cavity it is rapidly fatal.

EXPLORING SYRINGE (should only be used as the first step of an operation when the patient is anæsthetized, and never through the peritoneal cavity).—A deep puncture (3 in.) is made in the 10th, 9th, 8th, or 7th spaces in order from below upwards, first in the scapular line and then in the mid-axillary line. If it has gone through the diaphragm, THE SYRINGE MOVES WITH RESPIRATION.

Diagnosis is made by attention to the history and signs of abdominal disease.

IN PLEURAL EFFUSIONS, especially pyopneumothorax, the history and signs are those of lung disease. The heart is displaced laterally and not upwards. The exploring needle does not move with respiration. The breath-sounds are more widely abolished, and the area of amphoric breathing is much larger.

IN HEPATIC TUMOURS AND ABSCESES the liver moves with respiration, except in malignant disease, and there is much less tenderness or hectic.

IN PNEUMOCOCCAL PERITONITIS WITH PNEUMONIA the peritoneal condition is usually generalized ; otherwise it would, in fact, constitute a subphrenic abscess.

Prognosis.—About half of all cases die—all cases which are not operated on. The prospect after posterior operations is rather better than after anterior ones.

Treatment.—Free opening and drainage directly the diagnosis is made. The operations may be conducted by various routes according to the position of the abscess ; only the first two routes are common.

ANTERIOR ABDOMINAL ROUTE, for anterior intraperitoneal collections, the general peritoneal cavity not being opened. A supplementary drain through the loin is often required, especially in right-sided cases.

POSTERIOR TRANSPLEURAL ROUTE.—The incision follows the track of the exploring syringe. A rib is resected not higher than the 7th, and the diaphragm sewn to the parietes. The abscess is then opened through the diaphragm.

OTHER ROUTES—Anterior transpleural, lateral transpleural, subpleural, and lumbar openings may be required. The last is often necessary to drain collections of pus in the subhepatic pouch.

CHAPTER XXXVII.

APPENDICITIS.**Anatomy of Appendix.—**

LENGTH.—Four inches, or anything between three-quarters of an inch and nine inches.

DIAMETER.—Quarter of an inch (unless distended).

POSITION.—Base joins cæcum one inch below the ileocæcal valve : Point marked on surface, middle of a horizontal line between right anterior superior iliac spine and the mid-line.

It is found in the following positions, in the order of frequency named, when inflamed: (1) At the ileocæcal angle; (2) Behind the cæcum; (3) In the pelvis; (4) On the outer side of the cæcum; (5) Incarcerated in one of the retro-peritoneal fossæ; (6) In front of the cæcum; (7) In the sacs of inguinal, femoral, or umbilical herniæ.

DIRECTION: (1) Upwards and outwards behind the colon; (2) Downwards and inwards over the pelvic brim; (3) Upwards and inwards behind the ileum.

GUIDE TO POSITION.—The muscular *tæniæ coli* converge to it.

STRUCTURE.—The following layers are found from within outwards:—

1. Mucous membrane, containing simple mucous glands.
2. Submucous tissue, containing large solitary lymph follicles, each lymph follicle having a basal lymph sinus surrounding it on one side.
3. An ill-developed muscularis mucosæ.
4. A layer of circular muscle fibres.
5. A layer of longitudinal muscle fibres. In one or two places 4 and 5 are deficient, and through this 'hiatus muscularis' the submucous and subperitoneal layers are in direct communication, and by this channel bacterial infection often takes place.
6. Subperitoneal connective tissue containing blood- and lymph-vessels.
7. Peritoneum.

ARTERY AND VEIN.—Branches of the ileocolic which run behind the ileum—Branch from left ovarian is probably only a pathological variation.

MESENTERY.—The fold of peritoneum containing the artery in its free border—Attached to the iliac mesentery.

Anatomy of Appendix, *continued*.

ILEO-APPENDICULAR FOLD AND FOSSA.—A recurrent branch from the artery of the appendix to the ileum lifts up a peritoneal fold and bounds a fossa of this name.

Etiology.—

SEX.—Males to females as four to one.

PREDISPOSING CAUSES.—

OBSTRUCTION TO THE LUMEN OF THE APPENDIX.—Swelling of mucous membrane—Kinking of a long appendix—Chronic constipation—Fæcal concretions.

OBSTRUCTION TO THE CIRCULATION.—Owing to vessels lying behind the cæcum. Owing to the artery not running out to the end of the appendix.

FOREIGN BODIES.—Very rare.

EXCITING CAUSES.—

MICRO-ORGANISMS.—*Bacillus coli* and staphylococci are common. Streptococci, tubercle, and actinomycosis are rare.

ULCERATION OR INFLAMMATION of the mucous membrane gives entry to the above.

Pathological Anatomy (*Fig. 123*).—

EROSION of mucous membrane by concretion, foreign body, or kinking.

MUCOUS MEMBRANE becomes generally inflamed or ulcerated. Sloughing from pressure, thrombosis, or toxic action of bacteria.

BACTERIAL INVASION occurs through the bases of the mucous glands, or generally through the base of an ulcer. Thence the lymphatic tissue is invaded, and by this means the process spreads to the other coats, and eventually to the peritoneum. Bacterial infection of the peritoneum may occur without demonstrable perforation, ulceration, or gangrene.

ARTERY IS OFTEN THROMBOSED.—This may cause gangrene, as there are no collaterals to carry on circulation.

VEINS MAY BECOME THROMBOSED.—Portal pyæmia and hepatic abscess may result.

PERITONEUM.—Plastic or suppurative inflammation.

WALL OF THE APPENDIX AS A WHOLE undergoes: (1) Coagulation necrosis, or (2) Sloughing, or (3) Perforation.

CONCRETIONS occupy the lumen in a large proportion of the worst cases. They are usually formed of a mass of bacteria agglutinated round some fæcal residue. In many cases they bring about ulceration, perforation, or gangrene.

FOREIGN BODIES, e.g., pins, worms, or fruit seeds, are rarely present, and then may be related to the cause of the inflammation.

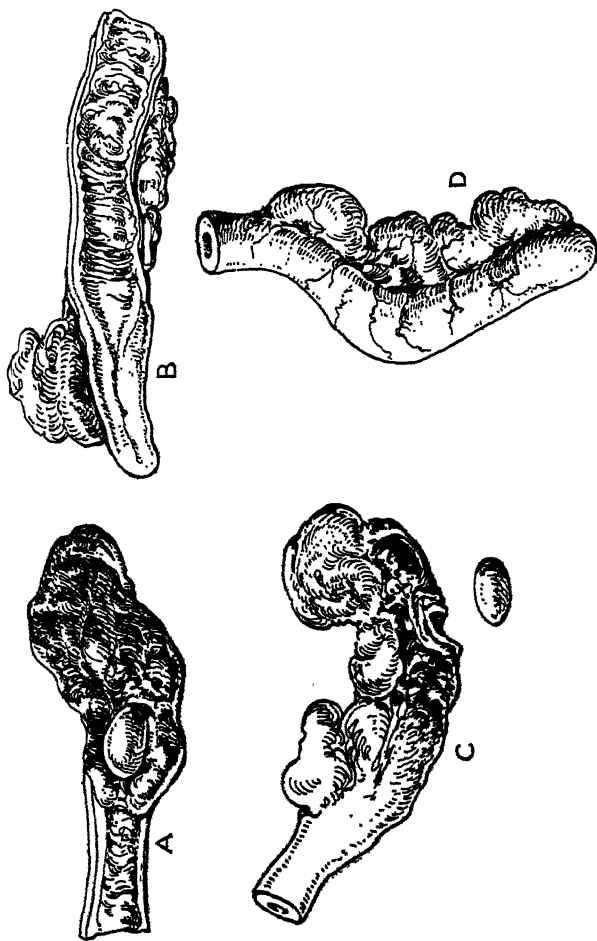


Fig. 123.—Typical conditions of appendicitis. A, Gangrene of portion beyond a concretion; B, Obliteration of tip by old inflammation; C, Ulceration and sloughing, with liberation of a concretion; D, Subacute inflammation with dilated vessels, and fat-laden mesentery.

Appendicitis—Pathological Anatomy, *continued*.

THE LUMEN, in addition to being occupied by concretions, may undergo one or more of the following changes :—

1. It may be obliterated by destruction of the mucous membrane and the union of the submucous tissue. This rarely affects the entire organ.
2. Stenosis may be produced at one point, as in the last case, or by kinking.
3. Dilatation of the lumen beyond the stenosis by either mucus or pus.

STRUCTURES IN THE NEIGHBOURHOOD.—(1) Plastic peritonitis; (2) Suppuration limited by adhesions; (3) Diffuse peritonitis.

EXTENSION.—The cæcum, ileum, and peritoneum in iliac fossa are almost always involved. Omentum is generally involved. Pelvis and uterine appendages are often involved. Lower abdominal contents often. Whole of the abdominal contents rarely.

Varieties.—

1. Appendicitis without involvement of the peritoneum.
2. Appendicitis with plastic peritonitis.
3. Appendicitis with localized suppurating peritonitis.
4. Appendicitis with generalized peritonitis.
5. Relapsing appendicitis—probably a succession of attacks similar to 1, 2, or 3.

Clinical History.—

GROUP 1.—WITHOUT PERITONEAL INVOLVEMENT.—

PAIN.—Sudden, sharp, and recurring at intervals; felt in right iliac fossa. Tenderness over this region.

TEMPERATURE.—Little or no rise.

DIGESTION.—Loss of appetite, furred tongue, constipation.

ANATOMY.—Appendix is long, or kinked, and the mucous membrane is often ulcerated and the wall invaded by bacteria.

COURSE.—Mild relapsing attacks.

GROUP 2.—WITH PLASTIC PERITONITIS.—

ONSET, in this and succeeding types.—General abdominal pain, colicky, and often referred to the umbilicus or epigastrium. Later, vomiting once or twice, and then after an interval local signs appear as given below.

FEVER.—Temperature rises to 101° or 102° F.

LOCALLY.—A resistant mass is felt over appendix. Most marked after third day.

TENDERNESS at first over region of ileocaecal valve, one-third distance between right anterior superior iliac spine and umbilicus—McBurney's point.

COURSE.—Clears up in about three weeks. Very liable to relapse.

ANATOMY.—Local plastic peritonitis matting together cæcum, appendix, ileum, and omentum.

GROUP 3.—WITH LOCALIZED SUPPURATING PERITONITIS.

ONSET.—Generally abrupt and severe. Often in the early morning during sleep. Sometimes preceded by malaise and indefinite pain and tenderness.

LOCALLY.—General abdominal distension and tenderness, most marked in right iliac fossa.

Right iliac fossa presents: (1) Muscular resistance and tenderness for first three to five days; (2) Indefinite resistant mass for third to seventh day; (3) Mass becomes dull to percussion. Skin dusky and œdematous.

Rectal examination shows marked tenderness on right side; boggy or fluctuating swelling later.

Right leg drawn up.

TEMPERATURE.—Rises to about 104° F., with occasional rigor.

Afterwards either: (a) Stays high, especially with gangrene; or (b) Drops while pulse increases.

RESPIRATION.—Almost entirely thoracic. Increased rate.

PULSE.—Rises to 100–120. Occasionally remains slow throughout.

ANATOMY.—Appendix is usually perforated or gangrenous, but suppuration may occur in the absence of gangrene, perforation, or ulceration. A collection of stinking pus is surrounded by adhesions.

ABSCCESS SPREADS: Down into the pelvis; up behind the colon to right kidney; through the abdominal wall; into upper abdomen.

ABSCCESS BURSTS: Into bowel, cæcum, ileum, or rectum; externally; or into peritoneal cavity.

DIGESTIVE ORGANS.—Tongue furred and dry. Constipation generally absolute. Vomiting severe at first and subsiding later. Small quantities of mucus, pus, or undigested food can often be detected in the motions. Rarely blood is passed by the bowel.

MICTURITION is sometimes painful, and this generally indicates that the inflammatory process is adjacent to the bladder.

COURSE.—Acute symptoms last about five days. Then usually subside and give place to those of a local abscess, or merge into (1) General peritonitis, or (2) Portal pyæmia.

GROUP 4.—WITH DIFFUSE PERITONITIS.—

ONSET and early symptoms as in last group.

LOCAL SIGNS.—Except for the right lower quadrant being most tender, there are no local signs. Signs of general peritonitis

Appendicitis—Clinical History, *continued*.

rapidly set in : abdominal distension, immobility, rigidity, and tympanites.

TEMPERATURE.—High at first, generally falls, or may be sub-normal during the rest of the illness.

PULSE rises to 120, and gets more rapid and smaller.

ANATOMY.—Appendix is perforated or gangrenous. Thin, stinking, seropurulent exudation lies between the coils of intestine, unlimited by any adhesions.

COURSE.—Patient dies in three to six days of general peritonitis.

GROUP 5.—RELAPSING APPENDICITIS.—

RECURRENT ATTACKS of inflammation or of plastic peritonitis in or round a damaged appendix.

SYMPTOMS or signs are similar to 1 or 2.

RECURRENCE occurs at intervals of months or years. Intervals tend to become shorter. Recurrent attacks may lead to an abscess ; seldom or never lead to diffuse peritonitis.

ANATOMY.—Appendix may be : (a) Kinked, stenosed, dilated, its walls being invaded by bacteria, the peritoneum quite unaffected ; " or (b) Inflamed and bound down in a mass of adhesions.

Diagnosis.—

GENERAL SIGNS.—Abrupt onset of generalized abdominal colicky pain, then vomiting, then, with involvement of peritoneum, appearance of local signs.

LEUCOCYTOSIS with a greatly increased proportion of polymorphonuclear cells is always present with a peritoneal exudation or suppuration. In appendicitis it is never absent except in the mild cases where the peritoneum is not involved, or the fulminating cases when the infection is so intense that there is no power of vital reaction.

LOCAL SIGNS.—Tenderness, pain, and resistance in right iliac fossa are the cardinal signs of appendicitis. Tenderness and swelling felt per rectum are of great help in diagnosis in a fat or distended subject.

THE DIAGNOSIS OF MILD OR RELAPSING CASES has to be made from :—

BILIARY COLIC.—Jaundice. Often no rise of pulse or temperature. Tenderness in upper right quadrant.

RENAL COLIC.—Pus, cells, or crystals in urine. Affection of micturition. Pain shooting into genitals or leg.

MOVABLE KIDNEY.—Kidney is felt to be mobile. Symptoms referable to micturition.

OVARITIS.—Enlarged, tender, or prolapsed ovary. Often disturbance of menstruation.

VISCEROPTOSIS with large floppy cæcum, often with Jackson's veil.—Attacks of pain in this condition are more frequent, of shorter duration, or may be constant pain in the right iliac fossa with frequent exacerbations. Relieved by recumbency.

THE DIAGNOSIS OF LOCAL SUPPURATIVE PERITONITIS from :—

PELVIC ABSCESS, especially parametritis. Uterus is felt fixed and displaced.

ILIAC OR PSOAS ABSCESS.—Signs of bone disease. Abscess is 'cold'.

NEW GROWTH OF CÆCUM.—History of constipation and diarrhoea. Abdominal distension of long standing. Mass is hard, well defined, and not tender.

EARLY INTUSSUSCEPTION.—Mass is not specially tender. Alters in size, shape, consistency. Passage of bloody mucus per anum.

COLITIS.—Passage of large quantity of mucus or casts per rectum. Tenderness, if present, is over the whole course of the colon.

INFLAMED UTERINE APPENDAGES, e.g., pyosalpinx or small ovarian cyst.—By bimanual vaginal examination.

THE DIAGNOSIS OF ACUTE DIFFUSE PERITONITIS from perforating gastric, duodenal, or intestinal ulcer; acute pancreatitis; acute intestinal obstruction; ruptured gall-bladder; ruptured extra-uterine gestation; ruptured pyosalpinx (*see* Chap. XLVI).

Prognosis is always a matter of doubt.

BAD SIGNS.—Absence of local resistant mass. Persistent high temperature. Temperature low, with rapid pulse. General abdominal distension. Marked constipation with vomiting. Persistent hiccough. Absence of leucocytosis, in the presence of grave signs of infection.

Treatment.—

GENERAL.—Bed. Hot fomentations. Low diet, e.g., whey or meat juices. Enemata: soap-and-water or turpentine.

DRUGS.—Opium only as a preliminary to operation, or if operation is refused. Not when diagnosis is uncertain. Purgative medicine is always dangerous, because it is liable to cause perforation of an inflamed appendix, by causing active peristalsis. This is especially the case in children.

OPERATION, with removal of appendix and suture of abdominal wall without drainage within the first 24 hours of the attack, is the treatment to be aimed at.

IF CASE IS DOUBTFUL.—Rest in bed in Fowler position, fomentations, enemata, and fluid diet, taking pulse and temperature every 2 hours. Never give morphia. Never give aperients,

Appendicitis—Treatment, *continued*.

as these are liable to cause perforation if the appendix is inflamed, by increasing peristalsis; especially is this the case in children.

The appendix should be removed at any stage in the disease if the diagnosis is reasonably clear.

DANGER OF POSTPONEMENT OF OPERATION is especially great in children. Normal temperature and relief from the primary pain are no grounds for non-intervention, because both these often accompany gangrene of the appendix.

OPENING OF ABSCESS WITHOUT REMOVAL OF APPENDIX is indicated in cases operated upon late in the disease (e.g., about the tenth day) when a localized abscess with dense adhesions is found, while the appendix is deeply buried.

PERSISTENT SINUS OR FÆCAL FISTULA AFTER OPERATION.—This may be due to: (1) Failure to remove the appendix; (2) Part of the appendix having been left; (3) Base of appendix remaining open into the wound; (4) Sloughing of wall of the cæcum; (5) A fæcal concretion left behind; (6) An infected non-absorbent ligature. Most of these conditions can be dealt with by opening up the wound. Otherwise ileo-colostomy through a median incision will be necessary.

CHAPTER XXXVIII.

INJURIES AND DISEASES OF THE STOMACH.

Examination of the Stomach.—

INSPECTION AND PALPATION may reveal a tumour, or peristaltic contractions. More elaborate methods of distension and auscultation have been superseded by X-ray examination.

FRACTIONAL TEST MEALS.—

Rehfuß's modification of Einhorn's tube is swallowed by patient first thing in the morning, having had no food for 12 hours previously. This tube is rubber, the size of a No. 6 catheter, having a perforated bulbous end containing a weight. This is swallowed until at least 16 inches from teeth. The whole of the fasting juice is withdrawn, the nature and amount of this is charted, and it is tested for presence of bile, starch, blood, total acidity, and free HCl.

A pint of test gruel is then swallowed with tube *in situ*, and 10 c.c. of gastric contents is withdrawn with a syringe attached to free end of tube every quarter of an hour until stomach is empty.

Each specimen is tested for blood, bile, mucus, and starch, and the amount of free HCl and total acidity estimated. The records from the analysis of these specimens is charted against the time (*Figs. 124, 125*).

In the normal stomach the acidity drops when meal is first taken, and then steadily rises owing to gastric secretion, to fall again as stomach empties and secretion diminishes. The normal stomach empties in about 2 to 2½ hours.

X-RAY EXAMINATION OF OPAQUE MEAL.—A meal containing three ounces of barium sulphate, which is opaque to the rays, is given in bread and milk or gruel. The shadow shown on the fluorescent screen by the rays is observed, and the following points noted :—

POSITION OF STOMACH.—Presence of ptosis, displacement of stomach by adhesions or tumour.

OUTLINE OF STOMACH.—Tumours may show an irregular indentation on outline. An ulcer may show as a bulge or prominence of outline when filled with barium meal. Frequently opposite the ulcer there occurs a spasmodic contraction of the circular muscle coat of the stomach, showing as a marked indentation or incisura (*see Fig. 128, p. 444*).

MOVEMENTS OF STOMACH.—Normally the stomach is empty in just over 2 hours. More rapid emptying occurs with duodenal ulcer, delayed emptying in pyloric stenosis.

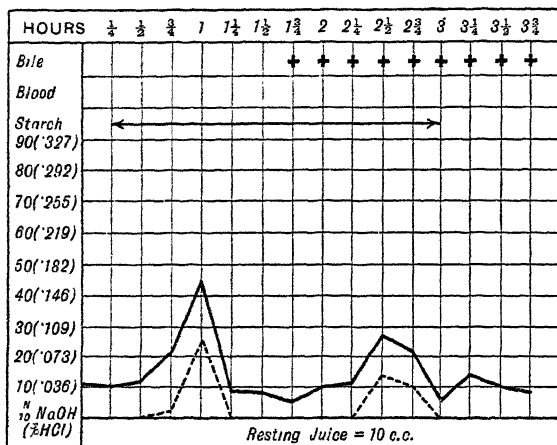


Fig. 124.—Typical curve of fractional test meal in gastric ulcer.
 — Total acidity. - - - - - Free HCl.

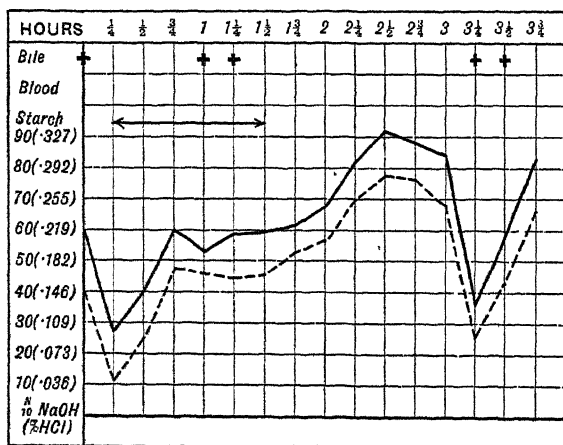


Fig. 125.—Typical curve of fractional test meal in duodenal ulcer.
 (After E. F. Guy.)

FOREIGN BODIES IN THE STOMACH.**Varieties.—**

1. **BODIES SWALLOWED BY ACCIDENT.**—E.g., tooth-plates, whistles, nails by carpenters. Diagnosis usually by history aided by X-ray.
2. **MULTIPLE BODIES SWALLOWED BY INTENT.**—Patients are usually lunatics or hysterical women.
3. **BODIES THAT GROW FROM SWALLOWING MULTIPLE SMALL PARTICLES.**—Pieces of hair, string, or wire swallowed at different times become welded to make a cast of the stomach. Hair ball or trichobezoar is found almost always in young girls.

Symptoms.—May be entirely absent, especially in small single bodies. Pain, vomiting, often streaked with blood, are common symptoms. Hair balls usually cause no symptoms until stomach is full; then pain, usually aggravated by meals, occurs; vomiting is unusual with hair ball. Almost always a palpable tumour is present.

Diagnosis.—X rays are of great value, as majority of swallowed bodies are opaque. In hair ball, when opaque barium meal is given, the meal is seen around the ball, spreading out over it as if forming a cup holding something in the stomach.

Prognosis.—Form of body is more important than size. Any article that can pass cardiac opening can usually pass through pylorus. Long articles like pencils, long nails, usually do not pass.

Treatment.—As long as no symptoms are present, and if from shape of body it is thought possible for it to pass pylorus, no treatment is required. Give mashed potatoes or thick porridge by mouth; this will tend to coat the body and aid passage through pylorus. Operation of gastrotomy should not be considered before a fortnight. Gastrotomy is required if after a reasonable time body is still present, if symptoms occur, or if body is obviously unable to pass.

INJURIES OF THE STOMACH.**Subcutaneous Wounds.—****CAUSES AND VARIETIES.—**

1. **EXTERNAL TRAUMA.**—Rare; direct blow in epigastrium, such as in a run-over accident. Only occurs if stomach is full; then sudden rapid increase of pressure causes rupture to take place at weakest part of wall, i.e., along greater curve.
2. **TRAUMA FROM WITHIN.**—May occur from foreign bodies within stomach; passage of cesophageal bougie; distension of stomach with gas for diagnostic purposes. These causes only bring about rupture when previous disease of stomach is present.

438 INJURIES AND DISEASES OF THE STOMACH

Injuries of the Stomach—Subcutaneous Wounds, *continued*.

3. SPONTANEOUS RUPTURE.—Rupture of apparently normal stomach is very rare. It has occurred from severe muscular effort such as lifting or vomiting.

SYMPTOMS.—

Those of perforated gastric ulcer.

Penetrating Wounds.—

VARIETIES.—

1. STAB WOUNDS.—May occur in civil practice, but are very rare.
2. SHOT WOUNDS.—Common in military practice.

SYMPTOMS AND SIGNS.—Similar to those of perforation of gastric ulcer. Hæmatemesis is common, escape of gastric juice is rare. The cause of death is most commonly severe internal hæmorrhage.

Treatment.—Prior to the Great War general opinion tended to conservative treatment such as morphia, absolute rest, nothing by mouth. Experience during the war showed that operative treatment gives a greater percentage of recoveries, and this, to be of use, must be early.

CONGENITAL STENOSIS OF THE PYLORUS.

Consists of a great hypertrophy of the muscular coat of the pylorus, with dilatation of the rest of the stomach. It is found soon after birth.

Pathology.—There is great hypertrophy of the muscular coat of the pylorus, almost entirely of the circular fibres. This hypertrophy is wholly concentric so that the lumen of the pylorus is greatly diminished but seen externally there is no increased diameter of the pylorus. The mucous membrane is thrown into longitudinal folds. The hypertrophy ends abruptly at the duodenum, but fades gradually away towards the body of the stomach (*Fig. 126*). The rest of the stomach is dilated and its walls somewhat hypertrophied.

Etiology.—The cause is still uncertain. Theories advanced are:—

1. CONGENITAL ABNORMALITY.—Unlikely, as usually no symptoms are present at birth. Not usually associated with other congenital abnormalities.
2. A RESULT OF SPASM.—Cause of spasm said to be due to:
(a) Inco-ordination of muscle fibres so that no relaxation occurs;
(b) Hyperacidity; (c) Hyperæsthesia of mucous membrane;
(d) Hyperadrenalism associated with the irritation of phimosia.

Clinical Features.—It is much more common in male than female children. The child at birth is usually quite healthy and of normal weight. There is usually an interval of 1 to 5 weeks or more before symptoms begin.

VOMITING.—At first slight and after each meal; later becomes characteristic of pyloric obstruction—namely, vomiting of large amounts at relatively infrequent intervals, 3 to 4 feeds being returned with each vomit. It is projectile, so that the contents of the stomach may be ejected a considerable distance.

LOSS OF WEIGHT is continuous and extreme. The skin is shrivelled and dry.

CONSTIPATION is marked.

VISIBLE PERISTALSIS in an obviously distended stomach is seen, especially after giving a feed.

PYLORIC TUMOUR.—This is the most characteristic sign, and is pathognomonic of the condition. It is present in 80 per cent of cases. It is felt as an elongated tubular mass about $1\frac{1}{2}$ inches long and $\frac{1}{2}$ inch in diameter at the site of the pylorus. It is often felt best immediately after a feed, and by supporting the child on the palm of the hand back upwards.

Treatment.—Medical treatment in the past resulted in a mortality of at least 80 per cent. General trend of opinion to-day is that when the condition is diagnosed operation should be done.

RAMMSTEDT'S OPERATION has superseded all others. This consists in the complete division of the whole length of the

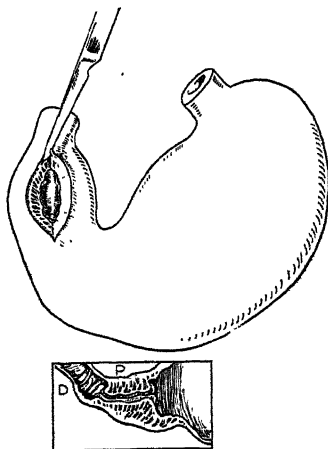


Fig. 126.—Congenital stenosis of pylorus. Lower figure shows the pylorus in section, with hypertrophy of the muscle coat. P, Pylorus; D, Duodenum. Upper figure shows Rammstedt's operation, the peritoneum and muscle being divided, whilst the mucous membrane is preserved.

Congenital Stenosis of the Pylorus—Treatment, *continued*.

hypertrophied area by a longitudinal incision down to but not including the mucous membrane, allowing this to bulge out (*Fig. 126*). No sutures are used except for the abdominal wall.

ACUTE DILATATION OF THE STOMACH.

A condition of rapid and enormous dilatation of the stomach, often ending fatally.

Etiology.—

1. AS A POST-OPERATIVE COMPLICATION.—It occurs most commonly after abdominal operations, especially on the gall-bladder, appendix, and pelvic organs; rarely after operations on the stomach. It may follow operations on the limbs and after local anæsthesia.
2. AS A COMPLICATION OF AN ACUTE ILLNESS.—Especially pneumonia after the crisis, and typhoid.
3. FOLLOWING INGESTION OF A LARGE MEAL.—There may be no previous operation or illness.

Pathology.—Post mortem there is an enormous dilatation of the stomach, often appearing to fill the whole abdominal cavity. It is U- or V-shaped, with a sharp kink at the lesser curve. The stomach wall is very thin and stretched. The dilatation does not stop at the pylorus, but involves the duodenum, often stopping abruptly at the point on the third part of the duodenum where the superior mesenteric vessels cross. In other cases the dilatation fades away into the ascending portion of the third part of the duodenum approaching the duodenal-jejunal flexure.

Causation.—Various theories suggested. It may be due to :—

1. EXCESSIVE SECRETION.—This was thought to be so rapid that the stomach became paralysed. This theory does not explain the cause of the secretion, or the fact that the greater part of the distention is due to gas, not fluid.
2. SPASM OF THE PYLORUS.—This does not account for the dilatation of the duodenum.
3. OBSTRUCTION OF THE DUODENUM BY THE SUPERIOR MESENTERIC VESSELS.—This view is supported by the fact that in about a third of the cases the dilatation ceases abruptly at the point of crossing by the vessels.
4. PARALYSIS OF THE STOMACH primarily, and then pressure of the dilated stomach on the duodenum.—Box and Wallace showed that post mortem a normal stomach can be enormously dilated with water by forcing it in from the cardiac end. The water does not pass through the duodenum even if the jejunum be cut across, or even if the superior mesenteric vessels and peritoneal folds in the neighbourhood be cut through. If,

however, the distended stomach be lifted off the duodenum, the contents of the stomach pass easily through the duodenum. This is now the generally accepted view.

Symptoms and Signs.—These usually do not arise until the second or third day after an operation—i.e., until after the anæsthetic sickness has passed off.

PAIN AND DISCOMFORT IN EPIGASTRIUM.—Often the first sign. Is constant, and is a feeling of distention. Not usually severe.

VOMITING.—This is the most marked feature. At first of small quantities at infrequent intervals, later becomes more or less continuous. Vomited material is at first undigested food, then bile-stained, and later black or brownish from blood and bile.

DISTENSION OF THE STOMACH.—Distension of the epigastrium comes on early; most marked at first to left of middle line above the umbilicus; later becomes extreme. Outline of the distended stomach may be visible.

SPLASHING OF STOMACH CONTENTS.—Readily obtained. Visible peristalsis is rare.

PASSAGE OF STOMACH TUBE allows escape of large quantities of gas and fluid, often with such suddenness as to resemble an explosion. Stomach fills up again almost at once.

GENERAL CONDITION OF PATIENT rapidly deteriorates. Collapse soon comes on, with intolerable thirst.

Diagnosis.—Severe prolonged post-anæsthetic vomiting, vomiting from peritonitis, or from intestinal obstruction, is differentiated by the absence of localized abdominal distension, succussion splash, and the characteristic evacuation of large quantities of gas and fluid by the stomach tube.

Treatment.—Despite all treatment, half the cases die. Operations such as gastro-jejunostomy or gastrostomy do not give such good results as the following method. The patient is laid prone with a pillow under the chest and another under the pelvis, and the foot of the bed is raised. This position is maintained for as long and as often as the patient can stand it, e.g., 15 minutes every 2 hours. Frequent repeated evacuation of the stomach contents by stomach tube. One c.c. of pituitrin is given 8-hourly, with $\frac{300}{500}$ gr. eserine 2-hourly for six doses.

ULCER OF THE STOMACH.

Ulceration of the stomach occurs in the following conditions:—

1. Acute gastric ulcer or erosion.
2. Chronic gastric ulcer.
3. As a part of acute or chronic gastritis.
4. From injury by foreign bodies or chemical erosions.
5. In association with hæmatemesis from back-pressure.

Gastric Ulcer—Occurrence, *continued*.

6. From specific infections, e.g., tuberculosis, anthrax, syphilis, and typhoid.
7. Carcinomatous or sarcomatous ulcers.
8. Granulomatous ulcers with Hodgkin's disease.

ACUTE GASTRIC ULCER OR EROSION.

Pathology.—The ulcers are usually multiple, and mostly found on the posterior surface and fundus of the stomach. They are small, 2 to 3 mm. in diameter, long or oval in shape, and have a characteristic sharp edge as if punched out of the mucous membrane. The floor is smooth, and usually formed by the muscular coat; there is no infiltration. They heal readily without contraction. They tend to open the blood-vessels of the submucous coat. During life no change can be seen on the peritoneal coat at the site of the ulcer, and after death they require careful search to see them, being best shown by holding up the stomach to the light and looking for light patches. These represent the ulcers.

Clinical Features.—Acute gastric ulceration is found clinically in the following conditions:—

1. AS A COMPLICATION OF SOME OTHER DISEASE.—Acute ulcers may occur in any septic intoxication, such as in acute suppurative appendicitis, or septicæmia, etc. Usually the history is that the patient is going downhill from some septic lesion, during the course of which, after a feeling of nausea, he vomits blood; this may be profuse, repeated, and fatal. The hæmatemesis may be preceded by a few days' epigastric pain and vomiting after each meal. There may be no sign or symptom of gastric ulceration, yet post mortem multiple acute ulcers may be found.
2. AS A CAUSE OF SEVERE HÆMATEMESIS.—There may be a few days' or weeks' history of gastric disturbance, such as pain after meals and vomiting, and then suddenly a large quantity of blood is vomited. This may be repeated and fatal.
3. AS A DISEASE IN YOUNG WOMEN.—Often associated with anæmia.

PAIN in epigastrium definitely related to meals, coming on after them.

VOMITING common, at the height of the pain. This does not give as complete a relief as in chronic ulcer.

HÆMATEMESIS very common, and may recur. Often profuse, but seldom fatal.

TENDERNESS, both superficial and deep, common in epigastrium.

Treatment.—Surgical treatment is never required. Rest in bed. Lenhart's diet. Hæmatemesis from an acute ulcer should be treated by medical means: morphia; $\frac{3}{ij}$ of adrenalin in equal quantity of water every half hour for six doses.

CHRONIC GASTRIC ULCER.

Pathology.—

ULCER.—Often very large, frequently several inches in diameter. Usually single, multiple only in 20 per cent or less. Most commonly found in pyloric part of stomach, nearer lesser curve than greater, and more often on posterior surface (*Fig. 127*).

SHAPE.—Round or oval.

EDGES.—Rounded, indurated, and heaped up, unlike clear-cut acute ulcer. Shows marked infiltration, so that whole mass may resemble carcinoma.

BASE.—Formed by sclerosed tissues adherent to stomach, commonly pancreas or liver.

DEPTH.—Considerable, so that usually the peritoneal coat is involved.

PERITONEAL COAT.—Shows small vascular points around edge of ulcer radiating into surrounding peritoneal surface. Often on surface is a fibrinous deposit, giving rise to adhesions.

The ulcer produces great contraction by healing. In its extension it may open a large blood-vessel outside the stomach, e.g., the gastroduodenal or splenic artery.

Causation.—The reason for an acute ulcer becoming chronic is not understood. Bolton found great difficulty in making an acute ulcer become chronic experimentally: repeated injection of gastro-toxic sera, increasing the acidity, feeding with bacteria, when an acute ulcer was present, did not make it become chronic. Theories:—

1. **EMBOLISM.**—Theory advanced by Virchow on the analogy of the size and shape and appearance of infarcts elsewhere. Although it is possible to reproduce ulcers by artificially occluding vessels of the stomach, it is rare to find ulceration of the stomach in conditions where emboli of kidney and spleen are common, except where a definite septic element is present.
2. **THROMBOSIS.**—There is some evidence to show that thrombosis of gastric vessels is followed by ulceration, but usual type of ulceration is not associated with general arterial degeneration, nor does it occur in patients suffering from peripheral thrombosis.
3. **NEUROPATHIC DISTURBANCE.**—In spinal lesions and injuries of the coeliac plexus, and after section of the vagus, ulcers may occur. Therefore the suggested usual cause is that the condition is similar to Raynaud's disease leading to small patches of gangrene. There is little to support this view, and patients with gastric ulceration seldom present nervous symptoms.
4. **BACTERIAL INFECTION.**—There is a considerable amount of evidence to show that acute ulcers are directly dependent upon a septic infection, e.g., in the mouth, tonsils, and especially the appendix. The path of the infection is probably the bloodstream. It is probable that an inflammation of the lymphoid

444 INJURIES AND DISEASES OF THE STOMACH

Chronic Gastric Ulcer—Causation, *continued*.

follicles arises by infection from the original focus; these become enlarged and inflamed and later necrotic, giving rise to ulcers.

5. **SPECIFIC GASTRIC POISONS.**—Bolton showed that by injecting the gastric cells of one animal into another of the same or different species he was able to prepare a gastro-toxic serum. If this serum was injected into an animal of the same species as that from which the gastric cells were obtained, acute ulcers rapidly formed in the stomach. These ulcers were due to the acidity of the gastric juice after the cells had been injured by the gastro-toxic serum, since if the HCl of the gastric juice was neutralized by giving doses of sodium bicarbonate before the injection of the serum, these ulcers did not form.

Etiology.—Men suffer more often than women—83 men to 81 women (Moynihan, 1923). Age, 30 to 50.

Symptoms.—

PAIN.—

SITE.—In epigastrium or lower thorax. Later in the history it radiates to whole epigastrium, and later still to back between the shoulder-blades.

RELATION TO FOOD.—This is extremely constant; the pain appears at a definite time after each meal, varying from $\frac{1}{4}$ to $2\frac{1}{2}$ hours. The time is constant in each attack and after

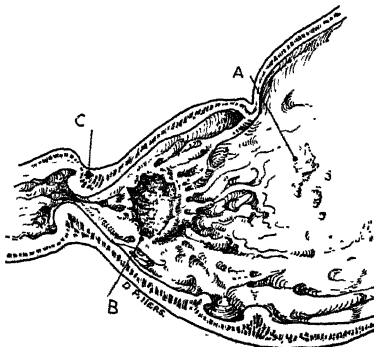


Fig. 127.—Gastric ulcer. Pyloric portion of stomach seen in longitudinal section. A, Recent ulceration; B, Chronic ulcer in early stage of malignancy; C, Hypertrophied pylorus. ($\times \frac{1}{2}$.)

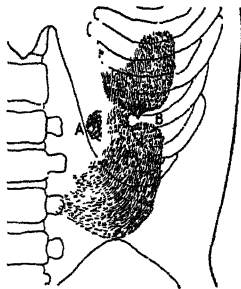


Fig. 128.—Radiogram after barium meal in case of chronic gastric ulcer. A, Niche representing crater of ulcer on lesser curve; B, Incisura or notch caused by spasm of stomach opposite ulcer.

each meal. It never comes on while food is being taken or immediately after a meal, but there is always a free interval between the meal and the onset of pain.

The pain continues for some time, and disappears as the stomach empties. There is always a painless interval before the next meal. The rhythm of gastric ulcer pain is: Food, comfort, pain, comfort; then food, comfort, pain, comfort. This is constant during the attack. The pain is immediately relieved by vomiting. It is also relieved by bismuth or alkalis. The site of the pain is no indication of the site of the ulcer. If pain comes on early after meals the ulcer is generally near the cardiac orifice; if late, the ulcer is near the pylorus.

VOMITING.—Only present in about 50 per cent of cases. It occurs at the height of the pain, and immediately relieves it.

HÆMATEMESIS.—Only occurs in 25 per cent of cases: 75 per cent of all cases of hæmatemesis are unassociated with any lesion of the stomach demonstrable at operation.

APPETITE.—Generally good. The patient often says he would like to eat anything, but is afraid to do so on account of the pain after.

GENERAL CONDITION.—In early stages of disease patients are fat and well. Later they come to look ill, and lose weight.

TENDERNESS.—There is usually no superficial hyperæsthesia, but deep tenderness is usually present over mid-point of pyloric plane.

The above symptoms, of which pain is the most prominent, occur in attacks. Each attack lasts 2 to 6 weeks and then disappears, whether medical treatment is given or not. A period of complete relief follows for 2 to 6 months, when another attack occurs, either without cause, or after a chill or over-exertion. This periodicity of attacks is extremely characteristic and almost pathognomonic of chronic ulcer. In the attack the symptoms are as described above, and the pain is constant in its appearance after each meal. The history of these periodical attacks usually extends for years. In the later years the attacks tend to lengthen in duration and have a shorter interval of freedom between.

Signs.—

TEST MEAL.—Free HCl and total acidity are slightly raised. Fractional test meal shows somewhat increased acidity and digestion lasts longer (*see Fig. 124, p. 436*).

X-RAY.—Position of stomach is often higher than usual, being drawn up by puckering of gastrohepatic omentum.

Outline of stomach shows a crater-like niche on lesser curve (barium in ulcer cavity), opposite to which is a well-marked persistent indentation or notch on the greater curve caused by spasm (*Fig. 128*). In expert hands X-ray examination gives 95 per cent correct diagnosis.

Chronic Gastric Ulcer, *continued*.

Treatment.—Medical treatment is unsatisfactory, because: (1) Though it may terminate present attacks, invariably another attack occurs later; (2) A healed chronic ulcer as a result of medical treatment has never been demonstrated post mortem or at operation; (3) It is powerless to prevent the onset of complications. Surgical treatment should be carried out as soon as the diagnosis is made.

GASTRO-JEJUNOSTOMY for ulcers at the pylorus.

GASTRO-JEJUNOSTOMY WITH EXCISION OF THE ULCER BY THE CAUTERY for small ulcers on the lesser curve.

PARTIAL GASTRECTOMY is the ideal for all types.

JEJUNOSTOMY for very large ulcers eroding liver or pancreas.

THE COMPLICATIONS OF CHRONIC GASTRIC ULCER.

1. Acute Complications.

- i. **Perforation.**—Perforation may be *acute*, leading to diffuse peritonitis and possibly later subphrenic abscess; or *subacute*, causing local peritonitis and subphrenic abscess. External gastric fistula follows rupture of abscess through abdominal wall; internal gastric fistula follows perforation into a hollow viscus.

ACUTE PERFORATION.—

FREQUENCY.—Occurs in 15 to 20 per cent of cases.

SIZE OF ULCER.—The anterior wall is perforated in more than two-thirds of the cases. Acute ulcers which perforate are near the cardiac end more often than the pyloric. The reverse holds with chronic ulcers.

SEX AND AGE.—Are those of chronic ulcer, viz., men more than women.

SIZE OF THE PERFORATION.—Varies from a minute aperture to one admitting two fingers.

HISTORY OF PRECEDING DYSPEPSIA is usually present, but is absent in about 10 per cent of the cases.

SYMPTOMS AND SIGNS.—

Pain, sudden and excruciating.

Shock and collapse, rapid, severe, and increasing (see Chap. XLVI).

Vomiting often occurs once and is rarely repeated.

Rigidity of upper abdomen; very hard and tender.

Liver dullness is obscured by gas.

Shifting dullness occurs in the flanks.

Signs of local peritonitis occur in the subacute cases: (1) In epigastrium, especially round pylorus; (2) In region of right iliac fossa; (3) As a subphrenic abscess.

DIAGNOSIS.—The sudden onset of acute epigastric pain with marked shock, followed by board-like and excessively tender epigastrium, in the majority of cases renders the diagnosis easy.

TREATMENT.—Open the abdomen in the mid-line above the navel. Examine the anterior gastric surface, beginning at the cardiac end, and then the posterior surface through an opening in the gastrocolic omentum. Close the perforation with a double layer of stitches. If this is impossible, sew omentum over it. Drain peritoneal cavity. Perform gastro-jejunostomy only if patient's condition justifies prolonging of op ration.

PROGNOSIS AFTER OPERATION depends on: (1) Condition of stomach—the fuller the stomach the worse the outlook; (2) Time between operation and perforation—if less than twelve hours the outlook is good, if more than thirty-six it is almost hopeless in acute cases; (3) Size of the perforation.

2. **Hæmorrhage.**—

CAUSES (of hæmatemesis in general).—

TRAUMA.—Blow or foreign body.

GASTRIC ULCER.—Acute or chronic.

OTHER SURGICAL CONDITIONS.—Cancer, aneurysm, cholecystitis, appendicitis.

FUNCTIONAL CONDITIONS.—Vicarious menstrual hæmatemesis; post-operative hæmatemesis.

GENERAL DISEASES.—Hepatic cirrhosis, purpura, scurvy, cardiac disease, leukæmia, enteric fever, septicæmic conditions.

HÆMORRHAGE FROM ULCERATION is, apart from traumatism, the only form amenable to direct treatment.

SOURCE OF THE BLEEDING is from capillaries in most acute ulcers, and from arteries in the chronic ulcers and the most severe and fatal forms of bleeding. The splenic, gastroduodenal, and right gastro-epiploic arteries are those most often eroded.

IN ACUTE ULCER only the small vessels are eroded, and there is no induration to prevent their natural closure.

Treatment.—(1) Absolute rest. Sucking ice. Ice to the epigastrium. Feeding entirely by the rectum for some days. Morphia for restlessness. Adrenalin chloride, 1-1000 solution, 10 min. by mouth. Blood transfusion. Later, Lenhartz diet. (2) Operation is rarely necessary, and only when the above has failed. The stomach must be opened and the bleeding area ligatured. A gastro-enterostomy should be performed also, to keep the organ at rest.

IN CHRONIC ULCER there are usually signs and history of a long-standing dyspepsia. The bleeding may be insidious at first, like that of secondary hæmorrhage. When severe it

Complications of Gastric Ulcer—Hæmorrhage, *continued*.

comes from eroded arteries which cannot contract or retract because they are buried in adhesions.

Treatment.—Medical treatment as above whilst hæmorrhage continues; when stopped, and patient's general condition is better, then operate.

2. Chronic Complications.

1. **Adhesion to the Liver and Pancreas.**—This and the succeeding three complications give rise to a characteristic change in the symptoms of chronic ulcer, in that the symptoms lose their periodicity. For years there may have been a regular periodicity in the occurrence of each attack, but when the ulcer begins to erode the liver or pancreas, the attack lasts much longer, six months or more. In addition, other features are :—

PAIN is more continuous throughout the day, but still increased by food. It is much more severe, and now often radiates more widely, even up to the left shoulder.

VOMITING as before, and when present still gives complete relief to the pain.

GENERAL CONDITION is distinctly poorer. Patients often show loss of weight and anæmia, thus suggesting carcinoma.

X-RAY EXAMINATION is often characteristic, revealing the pocket of the ulcer fixed in liver or pancreas.

DIAGNOSIS.—Often difficult from carcinoma.

TREATMENT.—Gastro-jejunostomy has not had such success with this complication as direct attack on the ulcer, whether by excision, cauterization, or knife, with gastro-jejunostomy. Partial gastrectomy gives the best results. Gastro-jejunostomy en 'Y' is suitable for large adherent ulcers incapable of treatment by other methods.

2. Pyloric Obstruction.—**CAUSES.—**

1. Gastric and duodenal ulcer.
2. Pyloric spasm and simple fibrosis.
3. Gastric tumour.
4. Perigastric inflammation.
5. Carcinoma of stomach.

CLINICAL FEATURES.—When occurring as a complication of chronic gastric ulcer there is usually a long history of periodic attacks of gastric ulcer symptoms in which, as the ulcer is near the pylorus, the onset of pain after meals occurs late. The attack lasts longer and longer with the onset of obstruction until the characteristic symptoms appear.

PAIN is much less, but constant throughout the day. It is still increased by food.

VOMITING is now constant in the attack, and occurs at infrequent intervals (once in a day or two days); it is large in amount, the contents of several meals being vomited.

GENERAL CONDITION becomes poorer.

PHYSICAL SIGNS of distention of the stomach may be seen, with visible peristalsis. Splashing is easily elicited. A tumour of the thickened pylorus may be felt. X rays show great gastric retention.

3. **Hour-glass Constriction.**—Hour-glass stomach is said to be either congenital or acquired, but the existence of the former is rare and even doubtful.

CAUSES.—Perigastric adhesions resulting from an ulcer. Perforation and adhesion of an anterior ulcer. Cicatrization of a transversely placed median ulcer. Carcinoma, either primary, or secondary to an ulcer.

ANATOMY.—The stomach is divided by a transverse constriction into two equal or unequal parts. The constriction is usually about the middle; it may be so narrow that a catheter can scarcely pass its lumen. Great puckering and scarring from ulceration are present, and indicate the causation.

CLINICAL FEATURES.—

SYMPTOMS.—Loss of periodicity of simple ulcer. Pain more constant and of increased severity. Vomiting now more frequent. If cardiac pouch small, regurgitation takes place after a few mouthfuls, resembling oesophageal obstruction. If cardiac pouch large, due to constriction being nearer pylorus, vomiting resembles that of pyloric obstruction. Almost all cases due to chronic ulcer occur in women; those occurring in men are all due to carcinoma.

SPECIAL PHYSICAL SIGNS.—

1. Fluid introduced through a tube cannot be all returned.
2. A gush of putrid fluid after washing the stomach clean.
3. Splashing felt after the stomach has been emptied by siphonage.
4. Gurgling sounds heard in the passage of gas and fluids from one cavity to another.
5. X rays show two cavities separated by a narrow channel of considerable length.

TREATMENT.—

1. **GASTROPLASTY.**—A division in the long axis of the stomach of the stricture, which is sewn up transversely. Only suitable in the absence of adhesions and induration.
2. **GASTRO-ANASTOMOSIS.**—Making a large anastomotic opening between the two pouches. It is successful only in the absence of pyloric stenosis.
3. **GASTRO-ENTEROSTOMY.**—Uniting the cardiac compartment to the jejunum.
4. **PARTIAL GASTRECTOMY.**—Necessary in malignant and advisable in some simple cases.

Complications of Gastric Ulcer, *continued*.

4. **Onset of Carcinoma.**—The frequency with which carcinoma occurs in a chronic ulcer is variously estimated. Figures varying from 30 to 70 per cent are given as the proportion of all cases of carcinoma of the stomach in which evidence of previous chronic ulcer exists. When occurring as a complication of ulcer, there is a loss of periodicity of the symptoms, the last attack lasting some months with more or less constant pain though still increased by food. The pain may not be so severe, but signs of general deterioration of the patient soon occur.

DUODENAL ULCER.*

Duodenal ulceration is similar to that of the stomach, and often occurs at the same time, but there are certain important characteristic differences.

FREQUENCY is about a quarter, or less, that of gastric ulcer.

SITUATION.—Almost always in the first part of the duodenum.

NUMBER.—Often multiple, one being opposite to another.

GASTRIC CONDITION.—In about 5 per cent there is an associated gastric ulcer.

AGE.—All ages are liable.

SEX.—Males are much more frequently affected than females : about four to one.

Symptoms are usually similar to those of gastric ulcer, pain, vomiting, and excess of free HCl being the rule (*see Fig. 125, p. 436*). Special characteristics are :—

1. Many cases are quite latent and only discovered post mortem.
2. Many cases are quite latent until a severe perforation or bleeding occurs.
3. **THE PAIN** is dull and aching or burning, felt to the right of the mid-line. It occurs three to four hours after meals, and often appears to be relieved by food ('hunger pain'). Attacks of pain lasting for two or three weeks are followed by intervals of freedom from pain lasting for months. The attacks are more frequent in cold weather. The pain comes on with great regularity at the same time every day.
4. **BLEEDING** is not so frequently observed as in gastric ulcer, because it is not looked for in the fæces. It may occur as hæmatemesis or melæna. Or it may be quite masked in severe or fatal cases, the patient bleeding to death into his own intestine. The gastroduodenal or right gastro-epiploic arteries are those most often eroded.

Varieties.—As in gastric ulcer, they are either **ACUTE**, with a special liability to perforation, or **CHRONIC**, with liability to hæmorrhage and cicatrization.

Complications.—

HÆMORRHAGE.—Is more likely to be fatal, and less amenable to medical treatment, than in gastric ulcer.

* Moynihan, *Duodenal Ulcer*.

PERFORATION.—It is more frequent and more fatal than in gastric cases. It is very liable to be mistaken for acute appendicitis, because the exudation gravitates into the right iliac fossa.

In subacute or chronic cases a subphrenic or other ABSCESS, or an internal or external FISTULA, may occur.

CICATRICAL CONTRACTION produces symptoms and signs indistinguishable from those of pyloric obstruction, and the condition must be treated in the same way.

OCCLUSION OF THE BILE-DUCTS, with lithiasis and jaundice. **PANCREATITIS**, from occlusion of the pancreatic duct.

CARCINOMA is so rare a development of duodenal ulcer as to be practically negligible.

Treatment.—Gastro-enterostomy. Occlusion of the pylorus by a ligature is also practised, especially for ulcers with much bleeding.

SIMPLE TUMOURS OF THE STOMACH.

Varieties.—Adenoma. Myoma. Lymphadenoma. Cysts. These are all very rare, but may cause signs of: (1) A very movable epigastric tumour; (2) Attacks of vomiting caused by the tumour catching in the pyloric aperture.

ADENOMA occurs as a polypoid mass with a narrow pedicle.

Possibly it is a precursor of malignant disease.

MYOMA may grow inside or outside the viscus.

CYSTS grow between the coats of the stomach or between the layers of omentum. They are probably formed by a budding off of an outgrowth from the stomach.

TREATMENT.—Removal, with careful microscopical examination.

SARCOMA OF THE STOMACH.

These form about 5 per cent of all malignant gastric growths.

Varieties.—Lymphosarcoma or spindle-celled.

SYMPTOMS AND SIGNS are the same as in carcinoma, but gastric dilatation is not so common. Also it is more usual for a large movable tumour to be formed than in the case of cancer. The spindle-celled variety may form a polypoid mass capable of local removal.

CARCINOMA OF THE STOMACH.

Etiology.—More common in men than women. Age: forty to seventy includes most of the cases; may occur at thirty, or even younger. Chronic gastric ulcer is sometimes its precursor.*

Anatomy.—

REGION AFFECTED.—Pylorus in 60 per cent; lesser curve, and cardiac end, about 10 per cent each; other sites together, 15 per cent; general, 5 per cent.

* The following figures are given by various authorities as the percentage of cases of cancer which develop from ulcer: Robson, 59; Rodman, 50; Moynihan, 66; Wilson and MacCarty, 71; Payr, 26; Kuttner, 43.

Carcinoma of the Stomach—Anatomy, *continued*.

NAKED-EYE APPEARANCE.—

1. COMMON TYPE.—Annular growth round the pylorus. Pyloric canal obstructed or obliterated. Growth ends abruptly at the duodenum; extends farther along lesser than greater curve. Stomach wall is thickened to half an inch or more. Muscle is hypertrophied in and near the growth. Mucous membrane is often destroyed by ulceration. Peritoneal coat is thick and puckered.
2. SOFT FUNGATING friable mass, with infiltrated base.
3. EXCAVATED ULCER, with everted edges.
4. GENERAL INFILTRATION and contraction of the whole organ —‘the leather-bottle stomach’.

HISTOLOGY.—

1. SPHEROIDAL-CELLED CARCINOMA.—Over 60 per cent. Generally of a scirrhus type. Columns of spheroidal cells invade all coats.
2. COLUMNAR-CELLED CARCINOMA.—Rather less than 40 per cent. Bases of the gastric glands invade the deep tissues. Growth consists of atypical glandular alveoli.
Both these forms are liable to certain modifications: (a) Colloid degeneration; (b) Encephaloid; or (c) Scirrhus type.
3. SQUAMOUS-CELLED CARCINOMA growing from the œsophagus is excessively rare.

EXTENSION.—

TO THE LYMPH-GLANDS along the lesser curve; in the portal fissure of liver; round the cœliac axis.

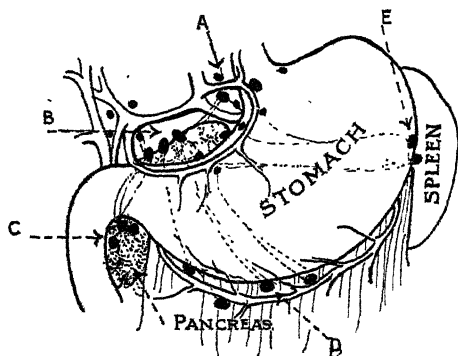


Fig. 129.—Lymphatics of the stomach. A, Glands round coronary artery; B, Glands along lesser curve; C, Subpyloric group; D, Group along greater curve; E, Group at the fundus. Note that A, B, and C are the important groups involved in the spread of cancer of the stomach. All of these are liable to involve the pancreas by adhesion and invasion.

TO THE PERITONEAL SURFACE, and thence by adhesions to liver, pancreas, colon, peritoneal cavity, anterior abdominal wall. THE GREAT OMENTUM early becomes permeated with cancer cells. THE PELVIC CAVITY may be engrafted by secondary growths comparatively early (probably by trans-coelomic implantation), and Douglas's pouch should always be examined for such growths.

Masses of glands may obstruct the portal vein and thoracic duct.

SUBMUCOUS TISSUE is always invaded much more than the muscular or serous coats, and it is in this tissue that the most advanced edge of the growth is found.

LESSER CURVE.—The most marked extension in most cases is along the lesser curve, following the line of the lymph-stream which leaves the stomach with the coronary artery (*Fig. 129*).

DUODENUM.—Usually, even in advanced cases, the growth stops abruptly at the pylorus.

Symptoms.—

1. CARCINOMA OF LESSER CURVATURE.—

a. INSIDIOUS ONSET.—First stage is often not referred to stomach, but patient first complains of weakness and loss of energy, loss of weight and appetite. Later there appears some discomfort or sense of fullness of ill-defined nature after meals. This becomes more or less constant, but is accentuated after meals. Later, vomiting or regurgitation of small quantities of foul fluid occurs, although this may be entirely absent. The symptoms progress until emaciation, presence of gastric tumour, or secondaries make the diagnosis clear. Jaundice from secondary deposits in the liver may be the outstanding feature.

b. FOLLOWING GASTRIC ULCER.—The previous history is that of many years of periodical attacks of typical chronic gastric ulcer. With the onset of carcinoma there is a loss of periodicity, the last attack being different from the others: it has lasted longer, and the pain is now constant throughout the day, though still being made worse by food. The pain as a whole is not so severe as previously. The symptoms outlined under (a) above appear.

2. CARCINOMA OBSTRUCTING THE PYLORUS.—There will be a history of a few months' epigastric pain, more or less constant, but increased by each meal and worse at the end of each day. Vomiting is early and is large in amount, shows evidence of decomposition, and occurs at relatively long intervals. It gives some relief to the pain. There is loss of appetite and marked loss of weight. On examination, visible peristalsis and splashing will be present, and a tumour is able to be palpated. The symptoms are thus those of a chronic ulcer obstructing the pylorus, but of more rapid progress, and

Carcinoma of the Stomach—Symptoms, *continued*.

with a history of only a few months' preceding dyspepsia, instead of, as in chronic ulcer, many years of dyspepsia.

3. **CARCINOMA OBSTRUCTING THE CARDIAC ORIFICE.**—The condition starts insidiously: loss of energy, loss of weight, then pain in epigastrium occur. The pain is present after each meal, and may persist throughout the day. Vomiting occurs early, and consists of a regurgitation of stomach contents. Later, symptoms of oesophageal obstruction arise, the pain occurs during the actual swallowing of food, and there is difficulty in the passage of food.

Physical Signs.—

TUMOUR.—Small, movable, and at level of 9th costal cartilage to the right of the mid-line in a pyloric growth. Indefinite epigastric mass indicates involvement of the body of the stomach, probably lesser curve. The mass, when seen early, moves easily up and down on respiration and less so from side to side.

GASTRIC CONTENTS.—Absence or diminished free HCl is found in about 80 per cent of cases. HCl is usually present in cases developing on site of a chronic ulcer. There may be presence of lactic and butyric acids, sarcinae, Boas-Oppler bacilli, and particles of growth. The vomit rarely contains free blood, but often contains intimately mixed altered blood of brown colour known as 'coffee-grounds vomit'.

X-RAY EXAMINATION.—This shows impaired motility of stomach wall, with a filling defect at site of growth. This is a valuable means of diagnosis.

IN LATE STAGE.—There is excessive emaciation, lemon or jaundiced skin, and loss of elasticity of skin. In the abdomen there is a hard mass in the epigastrium, with enlargement of the liver. Ascites. Oedema of legs. Severe pain in back and epigastrium. There may be a mass of glands in the left supraclavicular region from secondaries traversing the thoracic duct.

Diagnosis ought to be made in the early stages if possible. In the majority of cases, when the second stage is well marked radical treatment is impossible. Chief diagnostic signs are:—

EARLY.—Insidious dyspepsia occurring for the first time in a patient over fifty. Marked wasting. Diminution of free HCl in stomach contents.

LATER.—Tumour. Signs of dilatation of the stomach.

FROM CHRONIC ULCER.—In this there are: History of long dyspepsia. Wasting is not so marked, and is in proportion to the dyspepsia. Younger patient—thirty to fifty. Bleeding, if it occurs, is in large quantity, and nearly pure blood. Free HCl is increased. But since so many cases of cancer have their origin

in chronic ulcers, it is often impossible to be sure that a case of the latter is innocent. Such cases should be treated therefore by excision.

IN SIMPLE CHRONIC DYSPEPSIA, the wasting is not marked. There is no definite alteration in gastric contents.

IN SIMPLE DILATATION of the stomach or with an ulcer, HCl is present. Symptoms and emaciation rapidly improve with lavage.

IN INFLAMMATORY ADHESIONS round the gall-bladder, an indefinite mass may be present. A history of gall-stones or jaundice. Not much wasting. HCl present in stomach.

DOUBTFUL CASES.—All cases in patients over forty-five in whom pain and wasting do not yield to treatment, should be submitted to an exploratory operation.

Treatment.—

DIET.—Farinaceous and milk food. Fish, fowl, or finely minced meat. Avoid cellulose, seeds, fibres, skins, etc.

DRUGS.—Acids—hydrochloric, nitrohydrochloric. Creosote for fermentation. Opium for pain.

PALLIATIVE.—Lavage once a day, with plain water or Condy.

OPERATIVE.—

GASTRO-ENTEROSTOMY.—As palliative measure when pyloric obstruction exists. As preliminary to excision where possible. The average duration of life after gastro-enterostomy for cancer is only six months. It should be reserved for cases with marked gastric dilatation and vomiting caused by definite pyloric obstruction.

GASTRECTOMY.—The following points are important :—

1. Contra-indications to radical operation: Metastatic growths in the peritoneum or liver. Hard fixed glands round the portal fissure, coeliac axis, and in front of the aorta. Extensive fixation to the liver or pancreas.
2. In patients with marked pyloric obstruction and great debility the operation ought to be done in two stages, a gastro-enterostomy first, followed by excision of the growth a fortnight later.
3. A wide removal of the lesser curve, the small omentum, the great omentum, and the glands on the head of the pancreas should be made.

CHAPTER XXXIX.

INTESTINAL OBSTRUCTION.**Causes.—**

USUALLY ACUTE.—(1) Strangulation by bands and through apertures, including herniæ, internal and external; (2) Kinking; (3) Volvulus; (4) Intussusception; (5) Obstruction due to foreign bodies; (6) Paralytic ileus.

USUALLY CHRONIC.—(6) Stricture; (7) Tumours growing from the bowel wall; (8) Pressure of tumours outside the bowel; (9) Fæcal accumulation.

Sex and Age.—The male sex is specially prone to hernia, volvulus; the female sex to pressure by tumours, obstruction by gall-stones, and fæcal accumulation; children to intussusception and congenital stricture; patients over fifty to malignant growths.

General Pathology of Obstruction without Strangulation as produced by any form of stricture or new growth.—

THE BOWEL BELOW THE OBSTRUCTION is empty and contracted. The ballooned rectum below a rectal stricture is the only exception to this.

THE BOWEL ABOVE THE OBSTRUCTION is dilated and hypertrophied in proportion to the chronicity of the case. The mucous membrane is thick, catarrhal, and ulcerated. The ulcers (when the obstruction is in the colon) are specially common just above the obstruction, at the cæcum, and in the lower part of the ileum.

THE ULCERS usually cause death by perforative peritonitis, but they may form chronic fæcal abscesses or fistulæ, or very rarely a bimucous fistula, which relieves the obstruction.

SACCULATION OR POUCHING may be marked in either gut, but is commonest in the large. The pouches are sometimes filled with fruit-stones. Gangrene of the gut may rarely occur above the obstruction.

General Pathology of Strangulation as produced by a hernia or volvulus.—

THE INTENSITY OF THE CHANGES and of the symptoms depends upon: (1) The site of strangulation, being much more severe in the small than in the large intestine; (2) The length of gut involved; (3) The tightness of the strangulation, i.e., the degree of vascular occlusion.

THE GUT ABOVE THE STRANGULATION is red, congested, and distended with gas and fluid. Ulcers or gangrene above the site of strangulation are very rare.

THE GUT BELOW THE STRANGULATION is pale and empty, but very rarely may be the seat of some enteritis.

THE STRANGULATED LOOP becomes congested, œdematous, greatly distended with gas. Later its surface loses its lustre, is covered with sticky exudation, the colour becomes purple and black, and the gut gangrenous.

AT THE LINE OF STRANGULATION ulceration and linear gangrene are common, especially in the proximal loop (for further details, see STRANGULATED HERNIA, p. 489).

THE CHIEF FACTOR IN STRANGULATION is the vascular occlusion. This produces thrombosis of the vessels, great meteorism from decomposition of the intestinal contents, death of the tissues, with passage through them of bacteria.

Clinical Varieties.—(1) Acute; (2) Chronic; and (3) Chronic ending in acute.

ACUTE OBSTRUCTION.

Causes.—Internal strangulation, kinking, volvulus, foreign bodies, intussusception.

Symptoms.—

SHOCK.—Due to an implication of visceral nerves. General prostration; anxious, drawn face; great pallor. Subnormal temperature, cold sweats; small, soft, rapid pulse; shallow, quick respiration. Vomiting at the time of seizure.

This abdominal shock is common to all forms of 'peritonism', and at first there are few or no distinguishing features.

Its DEGREE is in this case proportioned to: (1) The suddenness; (2) The tightness of strangulation; (3) The nature of gut strangled, small bowel giving more shock than large, and jejunum more than ileum; (4) The amount of gut; (5) The youth of the patient. It passes off or becomes less within twenty-four hours in all except the most acute cases. It is much diminished by morphia.

PAIN.—Of sudden and severe onset. It has four different causes, which act in succession: (1) The actual nipping of the gut; (2) Abnormal peristaltic movements above the obstruction; (3) Distension of the gut; (4) Peritonitis.

It is CONSTANT, BUT SUBJECT TO EXACERBATIONS in complete obstruction; it is intermittent in partial obstruction.

It is REFERRED TO THE REGION OF THE NAVEL, and gives no indication of the seat of the lesion.

THERE IS A CONSPICUOUS ABSENCE OF TENDERNESS at first; in fact, pressure often relieves the pain, and the patient rolls about in restless agony.

Acute Intestinal Obstruction—Symptoms, *continued*.

LOCAL TENDERNESS MAY APPEAR about the third day over the site of the obstruction, and quickly gives place to the general tenderness of peritonitis.

THE PAIN DIMINISHES OR CHANGES ITS CHARACTER when perforation, gangrene, septic intoxication, or peritonitis sets in.

THE PAIN IS INCREASED after aperients, food, enemata, or palpation.

VOMITING.—There are three causes of vomiting: (1) Shock causes sudden vomiting at the onset, especially when the stomach is full; (2) Obstruction of the gut; (3) Peritonitis and distension. The vomiting of obstruction is first bilious and later stercoraceous, becoming so about the fifth day. The tongue is dry and foul.

STERCORACEOUS VOMIT is due to decomposition and bacterial products. It is most conspicuous in small-gut obstruction, and occurs early in proportion to the nearness of the obstruction to the stomach. It is caused by the return flow of an axial stream of fluid from the site of obstruction. Its occurrence is delayed by opium. It should be looked upon as a sign of impending death rather than a sign of intestinal obstruction.

TRUE FÆCAL VOMITING is excessively rare, and is due to a fistulous communication between the stomach and large bowel.

CONSTIPATION is absolute: neither fæces nor flatus pass in most cases. Due to reflex nerve paralysis. Lower bowel may empty itself spontaneously or by enemata, but even this is unusual.

SPURIOUS DIARRHŒA, with mucus and blood, which is so frequent in chronic cases, is only seen in acute intussusception among the acute cases.

TYMPANITIC DISTENSION due to meteorism is in proportion to the lowness of the seat of obstruction. When the small bowel only is involved, the central part of the abdomen is most distended, but when the colon is affected, the flanks swell out. It is decreased by strychnine and increased by morphia. Sigmoid volvulus gives the most extreme distension. It is not conspicuous in very acute cases (other than volvulus), but it greatly increases with the onset of peritonitis.

THE ABDOMEN remains flaccid until the onset of peritonitis. Visible peristalsis never occurs in a case which is primarily acute. Its occurrence proves a chronic cause.

TUMOUR is rarely felt in acute cases: (1) Intussusception, (2) Foreign body, (3) Matted intestine, (4) Internal hernia, may give rise to one, but except in the first they are rare.

URINE is diminished or even suppressed by shock. Later the small quantity is due to excessive vomiting. Indicanuria is usual in acute cases when the small gut is involved.

TEMPERATURE is usually subnormal throughout. A slight rise may accompany peritonitis, and an abrupt fall often follows perforation.

PULSE-RATE is at first slow, and there is a fall in blood-pressure. A rapid pulse is a grave sign.

PERITONITIS supervenes in a large proportion of fatal cases. It is caused by (1) a general transudation of bacteria through the gut, or by (2) perforation. Its onset is marked by the abdomen becoming tender and rigid, the pulse hard and thready, and where perforation has occurred, gas and free fluid may give the usual signs.

TOXÆMIA may occur with or without peritonitis, and is the last stage of all cases except the ultra-acute ones who die in the stage of shock. Delirium and unconsciousness, dry and cracked tongue, sunken eyes, ashen and livid complexion, restlessness, with profuse cold sweats, uncountable pulse, sighing respiration.

CHRONIC OBSTRUCTION.

Causes.—A stenosis or obstruction of the gut, which may be due to : (1) Kinking ; (2) Adhesions ; (3) Shrinking of the mesentery ; (4) Some kinds of volvulus ; (5) Neoplasms outside or inside the gut ; (6) Foreign bodies ; (7) Strictures, innocent or malignant—this cause being commoner than all the others put together ; (8) Fæcal accumulation.

Symptoms.—

ONSET is gradual, with indefinite ' dyspepsia ' and ever-increasing constipation.

PAIN is colicky and paroxysmal. Tends to be localized over the seat of obstruction. It is increased by aperients.

VOMITING is irregular and inconspicuous, often absent.

BOWELS.—Constipation is the rule, but it is very important to remember that regular daily actions may occur in spite of marked chronic obstruction. Spurious diarrhoea is common in stricture of the colon or rectum. It is caused by catarrh above the stricture. The motions are then very foul. Bloody mucus is common only when the disease is low down and of a cancerous nature.

SHAPE OF THE MOTIONS.—Occasionally in sigmoid or rectal disease the motions are compressed or tape-like.

ABDOMEN.—Great distension, both by gas and fæces. It is round and barrel-like, or wide and flat. Rumbling and gurgling are heard and felt.

VISIBLE AND PALPABLE PERISTALSIS is produced by : (1) Increased peristaltic efforts above a stricture ; and (2) Hypertrophy of the gut. It is therefore well developed in proportion to the chronicity of the case.

CONSTITUTIONAL.—There is much wasting. The complexion becomes muddy and yellow, with yellow conjunctivæ. The temperature rises occasionally, especially after aperients. The constitutional symptoms are proportional to the chronicity of the case rather than to the nature of the obstruction.

Differences in Chronic Obstruction in the Small and Large Bowels.—

IN STENOSIS OF THE SMALL GUT.—General symptoms of indigestion. The pain is influenced by the ingestion of food and the nature of the diet. Meteorism is late. Aperients often relieve. Vomiting is frequent. Tumour is felt in 30 per cent of cases of cancerous stricture. Live three to six months after the onset of symptoms.

IN STENOSIS OF COLON.—Indigestion is absent. Nature of food makes little difference to the pain. Aperients aggravate the symptoms, and may cause collapse, vomiting, perforation, or death. Vomiting is rare until obstruction becomes absolute, and then rarely becomes stercoraceous until the fourteenth day or later. Blood and mucus are common with spurious diarrhoea, especially in cancerous stricture. Ballooning of the rectum and tenesmus may be present when the lesion is low down. Tumour is felt in 40 per cent of cases of cancer. Live three to nine months after onset, but may live two years after colostomy.

CHRONIC OBSTRUCTION BECOMING ACUTE.

Causes.—May occur in any variety of chronic obstruction, when it may be brought on by: (1) Occlusion of a stricture by solid faeces; (2) Kinking of the gut; (3) Peritonitis at and above the stricture; (4) Purgatives; (5) Morphia.

Differences from a Primary Acute Attack.—The shock, pain, and suddenness of onset are much less. Visible peristalsis only found if a chronic obstruction has preceded the acute.

DIFFERENTIAL DIAGNOSIS.

1. ACUTE ABDOMINAL DISEASES OF OTHER KINDS.—
 Biliary colic—Renal colic—Lead colic—Ruptured gastric ulcer—Ruptured gut—Perforated appendix—Acute pancreatitis—Twisted ovarian cyst—Extra-uterine gestation—Ruptured pyosalpinx—Torsion of the testis. The diagnosis is made clear generally after the lapse of a few hours by the development of some special symptoms (*see* Chap. XLVI).
2. ACUTE PERITONITIS from a perforated appendix, stomach, or gall-bladder.—In this a rigor commonly occurs with the onset. An early rise of temperature is usual though not invariable. Tenderness is extreme, local at first, more diffused afterwards. The pain in peritonitis tends to subside sooner than in obstruction. The vomiting is less copious, less persistent, and less likely to be stercoraceous. Constipation is not so absolute. The abdomen is hard and rigid. Meteorism is early and diffuse. The patient lies still, with the knees up, as compared with the restless movements of one with obstruction. The pulse is very hard, of high tension. Leucocytosis appears in the majority of cases.

3. TUBERCULOUS PERITONITIS is especially likely to be mistaken for intussusception or for chronic obstruction. There are usually some fever and local tenderness.
4. CHOLERA.—Cases of acute obstruction with profound shock following diarrhoea, or cases of acute intussusception, have been mistaken for this.
5. DYSENTERY, MEMBRANOUS COLITIS, AND ACID INTOXICATION have been confused with intussusception.
6. THROMBOSIS OF THE MESENTERIC VESSELS.—An acute abdominal seizure occurs, with pain, vomiting, and collapse. Blood-stained diarrhoea may occur. The mesenteric veins or one of the arteries may be affected. In the latter case infarction of the gut supplied arises. The diagnosis is seldom made before operation.

TREATMENT.

1. NON-OPERATIVE.—

MORPHIA.—Relieves the pain and shock. Lessens peristaltic contractions, and therefore allays the vomiting. It causes a freer flow of urine by diminishing the nerve inhibition. It prevents the rapid development of an intussusception.

DANGERS.—It obscures diagnosis and tends to paralyse the bowel. It should, if possible, be withheld until the diagnosis is clear, and then given in doses of $\frac{1}{4}$ gr. in adults, and $\frac{1}{8}$ gr. in children.

ENEMATA.—A simple soap enema, one pint in bulk, given as early as possible. Generally it is returned unchanged. It should not be repeated. If it washes out the lower bowel it makes operative measures easier; it also aids in subsequent feeding by rectum.

PURGATIVES should in no circumstances be given if actual obstruction exists or is suspected. They will increase pain, shock, vomiting, and strangulation.

FEEDING.—All feeding by mouth is absolutely stopped. Thirst is best allayed by half a pint of water at blood heat given per rectum every four hours. A long drink of water (preferably hot) may be allowed occasionally. It causes vomiting and thus washes out the stomach.

WASHING OUT THE STOMACH often gives temporary relief from vomiting. It is specially indicated before the administration of an anæsthetic.

2. OPERATIVE.—

EVERY CASE SHOULD BE SUBMITTED TO OPERATION when complete obstruction is proved or probable. The prospects of success depend largely upon the EARLY PERIOD at which it is undertaken.

Intestinal Obstruction—Operative Treatment, *continued*.

THE ANÆSTHETIC.—The stomach should first be washed out, to minimize the danger of inhalation of vomited matter. As little anæsthetic as possible is given. Often local anæsthesia or SPINAL ANÆSTHESIA will be desirable.

THE INCISION should be median below the umbilicus. The only cases in which other incisions are justifiable are : (a) When the cause is known to be cancer below the sigmoid flexure, when an incision as for inguinal colostomy will be made ; (b) When there is a possibility of the case being one of acute appendicitis.

IN DESPERATE CASES.—A mere enterostomy of the nearest available coil of distended gut is sometimes all that can be done. It may relieve the urgent symptoms and allow a more radical operation later.

SEARCH FOR THE SEAT OF OBSTRUCTION.—The cæcum is first examined. If it is distended, the large bowel is at fault ; if collapsed, then the small gut is the seat of obstruction. The pelvis and left iliac fossa are next examined. The large bowel can easily be palpated in its whole course. The small bowel usually has to be brought out on to the abdomen.

PUNCTURE OF THE GUT.—When great distention exists and affects the colon, and especially the sigmoid flexure, a trocar is thrust in and the gas allowed to escape. A single stitch serves to close this. It is of little use to puncture distended small bowel, because this relieves only the coil punctured.

ENTEROSTOMY should always be performed after the cause of obstruction has been removed, if great distention, especially of the small bowel, exists. Tie in a Paul's tube.

THE TREATMENT OF GANGRENE OF THE GUT.—In desperate cases it is possible only to bring the dead parts outside and perform an enterostomy above the disease. But if the patient's condition allows it, an immediate enterectomy is to be performed.

SPECIAL VARIETIES.

I. INTERNAL STRANGULATION.

Internal strangulation, under bands and through apertures.

Causes.—The strangulating agents are of six kinds :—

- i. **PERITONEAL BANDS.**—These result from any form of local peritonitis, especially appendicitis, also from tuberculous disease in the intestine or glands. They become stretched and rolled into cords by intestinal movements. They are often attached to the region of the cæcum, the mesentery, the uterus and ovaries, or the umbilicus. They act in two ways : (a) As a

short band forming an arch, beneath which the gut becomes snared; and (b) A long band which forms loops in which the gut is knotted.

2. **CORDS FORMED BY OMENTAL ADHESIONS.**—Similar to above, a strand of omentum becoming attached to caecal region, pelvis, or hernial orifice. Commoner on left side.
3. **MECKEL'S DIVERTICULUM** is the remains of the vitello-intestinal duct. It is present in about 2 per cent of bodies. It is about 3 in. to 6 in. long, attached to the ileum 2 ft. to 3 ft. from the caecum. It may have a lumen of the same size as the gut, or its lumen is obliterated, and it forms a vitelline ligament. Its end may be free, or attached to the umbilicus, mesentery, or any other spot. It causes obstruction: (a) As a short band under which the gut is caught; (b) As a long cord which snares the gut; (c) As a free diverticulum with a knobbed end which knots itself round a loop of gut; (d) By producing kinking of the gut over it or by its traction; (e) By producing an intussusception or volvulus; (f) By a stricture formed at its junction with the gut.
4. **FALSE DIVERTICULA** are hernial protrusions of the mucous membrane through the other walls of the gut. They occur: (a) Towards the mesentery of the small intestine; (b) Into the appendices epiploicae of the colon. The latter may perforate or become inflamed, and so give rise to obstructing bands.
5. **ADHESIONS OF NORMAL STRUCTURES.**—(a) The appendix may be adherent by its tip to the mesentery, ileum, caecum, bladder, or parietes; (b) The Fallopian tube; (c) A part of the mesentery may form a tight band by the fixation of a portion of the gut; (d) Appendices epiploicae; (e) Ovarian pedicle.
6. **SLITS AND APERTURES.**—These may occur: (a) In the mesentery as the result of traumatism or congenital defect; (b) In the omentum; (c) In a membranous adhesion.

The Mechanism of Strangulation.—

It is nearly always the small gut which is caught, and generally the lower part of the ileum. When once caught, (a) the congestion produced by pressure on the veins, (b) gaseous distension, and (c) a twisting of the loop to form a volvulus, bring about strangulation.

Clinical Characters.—

ETIOLOGY.—Usually young adults, because these are the patients so liable to the different forms of peritonitis, hernia, or injury. In over 60 per cent there is a history of one or other of these conditions previously.

ONSET is sudden and abrupt in the majority of cases, and sometimes is determined by a straining movement, large meal, or purgative.

Internal Strangulation—Clinical Characters, *continued*.

PAIN is early, severe, and continuous. Vomiting is constant, copious, and severe, and becomes stercoraceous about fifth day. **COLLAPSE**, with profound prostration, is well marked.

ABDOMEN shows nothing characteristic. Very rarely a local dullness or an indefinite mass is caused by the engorged coils above the obstruction.

Course of the case ends fatally in about one week, the extremes being eight hours and twenty days. Patients seldom live more than three days after the onset of stercoraceous vomiting.

Prognosis.—Apart from operation it is always fatal. Death is early in proportion to the tightness of strangulation, the height of the bowel involved, the length of bowel caught.

Death is due to septic absorption, collapse, peritonitis, or perforation, in this order.

Special Points in Operative Treatment.—Bands and adhesions must be carefully divided between ligatures; diverticula removed, and the stumps sutured.

Internal Herniæ.*

Diaphragmatic Hernia.—In about half the cases the orifice in the diaphragm is congenital, and in the other half it is traumatic. The stomach, colon, and small intestine are involved, in this order. The symptoms may be acute or chronic. Diagnosis is practically impossible until the abdomen is opened.

TREATMENT will generally involve opening the pleural cavity to close the rent.

Duodenojejunal Fossa.—There are at least nine different varieties of these fossæ, the commonest formed by a peritoneal fold passing from the terminal part of the duodenum towards the left, and

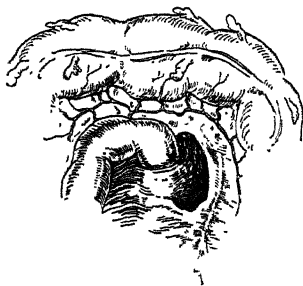


Fig. 130.—Paraduodenal, or left duodenojejunal, fossa, with inferior mesenteric vein in neck of sac.

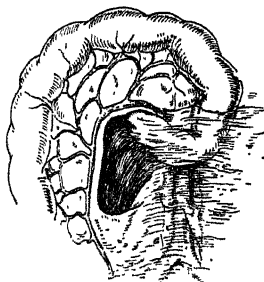


Fig. 131.—Mesentericoparietal, or right duodenojejunal, fossa, with superior mesenteric artery in neck of sac.

* Moynihan.

making a pouch looking upwards or downwards. The others are, chiefly, the paraduodenal, formed by the fold of peritoneum lifted by the inferior mesenteric vein, and those running under the root of the mesentery or into the transverse colon.

THE LEFT DUODENO-JEJUNAL HERNIA is eight times as common as the other. It is probably into the paraduodenal fossa. It extends to the left behind the descending colon, and has the inferior mesenteric vein and a branch of the left colic artery running in front of its neck (*Fig. 130*).

THE RIGHT DUODENO-JEJUNAL HERNIA extends behind the peritoneum towards the right behind the ascending colon. It enters a fossa in the root of the mesentery, and has the superior mesenteric vessels in front of its neck (*Fig. 131*).

THE SYMPTOMS vary, from those of dyspepsia and uneasiness, to chronic or acute intestinal obstruction. In the latter case the course is acute.

TREATMENT is difficult because of the large vessels in front of the neck of the sac.

Foramen of Winslow.—Very rare form, and only possible when an abnormal mesocolon exists. It usually involves the large intestine, but sometimes a large part of the small gut may be involved. The gut may further break its way through the gastro-hepatic omentum or through the transverse mesocolon, and then become strangulated. Over the neck of the sac at the foramen of Winslow run the portal vein, hepatic artery, and bile-duct. The symptoms are usually those of chronic obstruction with epigastric distention, followed by acute obstruction.

TREATMENT is difficult because the neck of the sac cannot be divided.

Intersigmoid Hernia.—The intersigmoid fossa is in the root of the sigmoid mesocolon, looks downward and to the left, and is bounded by the sigmoid artery. The symptoms are those of internal strangulation.

Pericæcal Hernia.—In the cæcal region: (1) Two fossæ may lie in front of the cæcum, determined by branches of the ileocolic artery—these are sometimes called the ileocolic fossæ; (2) One fossa may lie behind the cæcum and extend up as far as the kidney; (3) One fossa lies behind the mesentery of the appendix; (4) The ileo-appendicular fossa is bounded by the ileum above, appendix below, and the ileo-appendicular fold in front—this is often termed the ileocæcal fossa. Actual cases have occurred, chiefly in (2) and (4). The symptoms may be latent, or may resemble those of internal strangulation by other means.

II. KINKING.

Causes.—

A loop of bowel may be **KINKED OVER A BAND**. Adhesions or volvulus of the loop usually complicate this rare condition.

A loop of bowel may be **KINKED BY THE TRACTION** of a band or diverticulum.

Intestinal Obstruction—Kinking—Causes, *continued*.

ADHESIONS OF THE GUT to form V- or N-shaped loops. This is usually an after-effect of an inflamed or strangulated hernia, the symptoms coming on weeks or months after the hernia.

THE CONTRACTION OF ADHESIONS may compress the gut. This occurs round the colon, especially at the hepatic flexure, from gall-bladder inflammation.

THE MATTING TOGETHER of several coils of intestine may affect the small or large bowel. In the former it results from local peritonitis, and produces subacute obstruction; in the latter it results from chronic constipation and ulceration, and produces chronic obstruction.

Clinical Signs.—These cases are so rare that they do not form a definite clinical group. They may conform to any type of obstruction.

III. VOLVULUS.

Definition.—A kinking of a loop of gut, by either: (1) Rotating round its own mesenteric axis (*Fig. 132*); or (2) Falling across the pedicle of another loop of gut.

Locality.—Three regions may be affected, in the following order of frequency: (1) The sigmoid loop, i.e., the pelvic colon; (2) The small intestine; (3) The cæcum and ascending colon.

The Sigmoid Volvulus.—The loop and its mesentery are usually of abnormal length; the mesenteric attachment is narrow. The peritoneum of the mesocolon is dense, contracted, and often adherent. Chronic constipation, with distension of the loop, is the prominent predisposing cause. The proximal limb usually falls in front of the distal limb. The twist may be from half to three complete turns. As long as distension exists the volvulus cannot be reduced, or re-forms after reduction. In fatal cases the sigmoid becomes enormously distended, until it presses on the

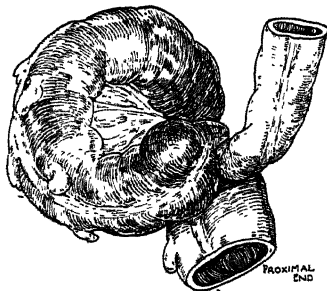


Fig. 132.—Volvulus of the pelvic colon.

liver and diaphragm, the latter being raised up to the level of the 3rd or 4th rib. The loop is intensely congested and hæmorrhagic. Its outer coats are often ruptured. Gangrene is frequent. The mesocolon is engorged. Peritonitis is of constant occurrence. The gut above is distended and sometimes perforated. Sometimes the sigmoid loop is intertwined with a loop of small intestine. The patients in the common variety are usually elderly males.

The Enteric Volvulus.—A loop of small gut has an abnormally long mesentery, or one whose attached border has been puckered by adhesion, e.g., by a caseating gland. A gall-stone in the bowel may bring about the twist. The coil, which may be from one to five feet in length, is enormously swollen, congested, or gangrenous. It is often filled with blood, but death occurs before perforation. Rarely two coils may be intertwined. Enteric volvulus occurs in patients under forty, and sometimes in children.

Cæcal and Colic Volvulus.—The rarest variety. The gut may be twisted: (1) Upon its own axis; (2) At right angles to its own axis, i.e., kinked; (3) Twisted as a loop round its mesocolic axis. The cæcum and ascending colon are the parts affected, and they are always the subjects of congenital malposition or possessed of a mesocolon. Rarely an ascending colic volvulus may be intertwined with a loop of small bowel.

Clinical Aspect of the Sigmoid Volvulus.—

ETIOLOGY.—Males are four times as commonly affected as females; usually the age is between forty and sixty. There is always a history of chronic constipation.

PAIN is early and severe, but is often intermittent or subject to exacerbations.

VOMITING is late and insignificant, rarely stercoraceous.

SIGNS OF PERITONITIS are early and constant.

ABDOMINAL CONDITION.—Rapid and enormous meteorism occurs from the distension of the sigmoid loop, which may be seen through the parietes and extends up to the diaphragm. Tenderness and rigidity are early because of peritonitis.

RESPIRATION is embarrassed by the rapid abdominal distension. The other forms of volvulus are too rare to permit of a clinical grouping. They usually cause acute, but sometimes intermittent or chronic obstruction.

Course and Prognosis.—Rapid (about one week) and fatal.

Death is due to asphyxia from pressure on the diaphragm, septic absorption, or peritonitis.

Special Points in Operative Treatment.—In sigmoid and colic volvulus the loop must be brought to the surface, evacuated through a small incision, untwisted, stitched to the parietes to prevent re-formation of the twist, and a colostomy completed.

IV. INTUSSUSCEPTION.

Definition.—A prolapse of one part of the gut into an immediately adjoining part. It causes one-third of all cases of intestinal obstruction.

THREE LAYERS OF BOWEL are concentrically placed one inside the other. Peritoneum is in contact with peritoneum and mucous membrane with mucous membrane.

The outer layer is the SHEATH or INTUSSUSCIPiens.

The middle layer is the RETURNING LAYER, and has its coats reversed, i.e., the mucous membrane is outside towards the sheath, and its peritoneum inwards towards the inner layer.

The inner layer is the ENTERING LAYER.

The inner and middle layers, whose apposed peritoneal coats usually adhere together, are known collectively as the INTUSSUSCEPTUM.

THE NECK is the junction of the sheath and returning layer where these grasp the inner layer.

THE APEX is the junction of the middle and inner layers.

Varieties.—

1. ENTERIC.—Includes 30 per cent of all cases. Composed entirely of small intestine. Usually only about 6 in. in length. The jejunum is four times as liable as the ileum.
2. COLIC or rectal.—Includes 18 per cent of all cases. Composed entirely of large intestine. Most common in the region of the sigmoid flexure. Usually quite short.
3. ILEOCÆCAL.—Includes 44 per cent of all cases. The ileocæcal valve travels down the colon, dragging with it both ileum and cæcum (*Fig. 133*). It is of large size, the apex formed by the ileocæcal valve often reaching the anus.
4. ILEOCOLIC.—Includes 8 per cent of all cases. The ileum prolapses through the ileocæcal valve, which, together with the cæcum, remains in its place. Secondary ileocæcal invagination usually occurs later.

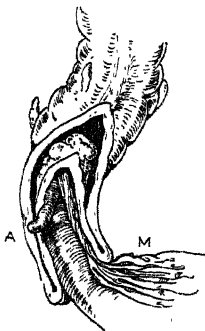


Fig. 133.—Intussusception, of the common ileocæcal variety. Part of the sheath and returning layer are cut away to show the entering layer. Apex formed by ileocæcal valve. A, Appendix M, Mesentery.

Anomalous or Rare Forms.—

1. Intussusception of the dying. Usually in the small gut, of small size, often multiple, may be retrograde, probably occurs during rigor mortis.
2. Retrograde intussusception is very rare, apart from those of the dying. Usually of short length, and in the colon.
3. Double, or even triple intussusceptions, are rare, and are caused by one intussusception becoming bodily prolapsed into the gut below, once, or even twice.
4. The iliaca-ileocolic is an intussusception of the ileum in which the apex formed by ileum reaches the ileocaecal valve and passes through it or pushes it in front of it.

The Mode of Growth is the same in all varieties except the ileocolic.

GROWTH TAKES PLACE AT THE EXPENSE OF THE SHEATH, i.e., more and more of the sheath becomes drawn in.

THE APEX REMAINS THE SAME THROUGHOUT, e.g., in the common ileocaecal variety, whether small or large, it is formed by the ileocaecal valve.

This is due to the fact that the inner and middle layers, whose junction forms the apex, have their peritoneal coats in apposition, and these adhere rather than glide over one another. But the outer and middle coats have mucous surfaces next to each other, and these readily glide, so that the intussusceptum slips down inside the intussusciens.

Pathological Anatomy.—

THE MESENTERY becomes dragged into the intussusceptum, between the inner and middle layers. (1) It is stretched by the traction of the growing intussusception. (2) It is constricted at the neck, where its bulk is largest. (3) Its tissues swell by exudation of inflammatory products.

THE BOWEL ABOVE is congested and dilated; only rarely in chronic cases is it ulcerated.

THE SHEATH OR INTUSSUSCIENS is little changed in acute cases; in chronic cases it is affected by local peritonitis, or it may be ulcerated or gangrenous, especially opposite the apex of the intussusceptum.

THE INTUSSUSCEPTUM.—

1. It is curved by the traction of the mesentery, so that its apex is directed against the wall of the sheath.
2. Oedema is most marked at the apex, which forms a globular tumour, and at the convex border.
3. Catarrh and desquamation of the mucous membrane occur, and account for the mucus and shreds in the stools.
4. Both its layers become engorged with blood, which exudes into the lumen.

Intussusception—The Intussusceptum, *continued*.

5. Gangrene is common in acute cases, and is most marked at the neck; in chronic cases it is most marked at the apex.
6. Separation and passage of the intussusceptum may affect the whole mass, which is passed as a complete double tube a few inches to a yard or more in length; or the tube may have unfolded itself, and so present only a single layer; or it may merely come away piecemeal, the latter being more common in chronic cases.

OBSTRUCTION is caused by: (1) The orifice at the apex being dragged upon by the mesentery, so as to be slit-like and apposed to the sheath; (2) The curved kinking of the intussusceptum by the mesentery; (3) The narrowing of the lumen by the pressure of oedema, hæmorrhage, and inflammatory exudation; (4) The blocking of the narrow lumen by some food debris.

STRANGULATION is caused by a compression of the vessels in the mesentery, by the tissues at the neck, by swelling of the layers of the intussusceptum, and by traction and torsion.

IRREDUCIBILITY is caused by: (1) Adhesions between the inner and middle layers, these occurring as a rule in chronic cases and exceptionally in acute cases; (2) Swelling of the intussusceptum, especially at its apex; (3) Bending or twisting of the intussusceptum; (4) A polyp or growth at the apex.

Etiology.—

SEX AND AGE.—Preponderance of males, especially in early life and in chronic cases. In acute cases 50 per cent occur before ten years and 25 per cent before one year. In chronic cases 50 per cent occur between twenty and forty.

PREDISPOSING CAUSES.—Diarrhoea, worms, masses of undigested food, polypus, new growth in the gut wall, Meckel's diverticulum, invaginated appendix (the last three very rare).

EXCITING CAUSES.—The irregular peristaltic contraction of the intestine induced by any of the above, either spasm or (rarely) paralysis causing a piece of gut to be swallowed, as it were, by the gut below.

INFLUENCE OF THE ILEOCÆCAL VALVE.—This acts like the sphincter ani, and tenesmus draws the cæcum over the ileum.

CAUSE OF GROWTH OF AN INTUSSUSCEPTION.—When once the condition is begun the peristaltic contractions of the sheath tend to drive down the intussusceptum.

Clinical Varieties.—These are: (1) Acute, which end fatally within one week, and form 50 per cent of all cases; (2) Sub-acute, which last up to a month, and form 30 per cent; (3) Chronic, which live more than a month, and form 20 per cent.

Symptoms of Acute Intussusception.—

ONSET is sudden, with pain or tenesmus.

PAIN is early. Severe at first, and may be less later when the intussusception becomes fixed. It is characteristically intermittent, the paroxysms coming on regularly and lasting a definite time. When a tumour appears the pain is localized to that region. On the whole the pain is less acute than in any other form of acute obstruction.

VOMITING is frequent at the onset, but irregular and inconstant during the course of the disease. It affords more relief than in other cases of obstruction. It varies inversely with the diarrhoea. It rarely becomes stercoraceous. It is most marked in enteric forms.

BOWELS.—Marked constipation is exceptional, and comes on after diarrhoea.

DIARRHŒA arises early from catarrh and excessive peristalsis; it also occurs late, and is specially offensive when the intussusceptum is sloughing.

BLOOD AND MUCUS occur conspicuously in 80 per cent of the acute cases, especially in children.

TENESMUS is often very prominent. It is an early symptom, and occurs in proportion to the proximity of the lesion to the anus. Patulence of the anal sphincter may occur.

SHOCK, THIRST, DIMINUTION OF URINE, are less marked than in other forms of acute obstruction.

RIGIDITY of the abdomen and **METEORISM** are slight and come on late.

TENDERNESS over a localized area may indicate the position of the lesion.

ABDOMINAL TUMOUR occurs in over 50 per cent of all cases. It is most frequent in ileocæcal and colic varieties. More distinct in children. It is sausage-shaped and curved. Most often seen over the descending or transverse colon. It gradually moves in the direction of the path of the colon; it may be made to retrace its path by forced enemata. It hardens during the attacks of pain and may disappear between.

RECTAL TUMOUR.—A mass which feels like a soft os uteri may be felt per anum, or may protrude from the bowel. This occurs in about one-third of the cases, especially in children, in whom it may appear on the second day of the attack. It occurs only in colic and ileocæcal varieties. From three to eight inches may protrude, and the ileocæcal valve and appendix orifice may be recognized at the apex.

The Course of the Case.—The acuteness is determined by:
(1) The site of the lesion—the higher being the more acute;
(2) The youth of the patient. Ultra-acute cases in infants under one year may die within twelve hours. Eighty per cent die within eight days.

Mortality among all cases is 70 per cent. Those that recover spontaneously are mostly the subacute cases.

Intussusception, *continued*.

Methods of Spontaneous Recovery.—(1) Natural reduction, especially after opium; (2) Spontaneous elimination of the intussusceptum. This occurs most frequently in adults. It affects about 30 per cent of the cases, and of these perhaps only 10 per cent recover; the remainder die from perforation, ulceration, or hæmorrhage of the bowel. The time of separation varies from three days to six months, occurring in most cases at the end of the first month. It occurs more frequently in the enteric than in the other varieties.

Chronic Intussusception.—Usually of the ileocæcal variety, and in adults rather than children. May last from a month to a year, the course being very irregular, and vomiting, pain, and diarrhoea all being variable in occurrence. Blood-stained motions with mucus occur in about half the cases. Visible peristalsis is well marked. An abdominal tumour is felt in about half the cases, and felt per rectum in about one-third. The mortality is very high—over 90 per cent.

Treatment.—

REDUCTION BY ENEMATA is now never employed.

OPERATION IN REDUCIBLE CASES.—Median incision. The tumour is brought into the wound. The apex is squeezed in an ascending direction through the sheath. It is useless and dangerous to drag on the entering layer at the neck. The greatest difficulty is in the final reduction of the cedematous apex. The appendix may be brought through the parietes and cut off to form a stoma through which feeding can take place. This also anchors the ileum and prevents recurrence. Or a simple stitch may be placed in the last part of the mesentery, fixing it to the parietes.

OPERATION IN IRREDUCIBLE CASES.—

BARKER'S OPERATION.—If the sheath is healthy, first tuck a little more intussusceptum into the sheath, then sew the two together by continuous stitch; open the sheath by a longitudinal opening and withdraw intussusceptum; cut it off transversely, sewing together the two layers in stump.

TOTAL RESECTION of the intussusception is indicated only when the sheath is gangrenous. The formation of an enterostomy is nearly always fatal in children.

V. OBSTRUCTION DUE TO FOREIGN BODIES.

I. Swallowed Foreign Bodies of an indigestible nature.—

- a. Metal and other hard substances swallowed by accident, e.g., tooth-plates, or by design by lunatics or showmen. These usually pass per anum, but they may become lodged anywhere, especially in the cæcum, and cause obstruction. More commonly they perforate the peritoneum, the parietes, or some other viscus, e.g., the bladder.

- b. Sharp foreign bodies, e.g., pins or nails. These may accumulate in the stomach or duodenum, or perforate the alimentary canal and wander to distant parts without causing symptoms.
 - c. Accumulated masses of débris. Hair, thread, fibres, fruit-stones or skins. Hair-balls may be found in lunatics and hysterical women who chew their own hair.
2. **Gall-stones.**—Gall-stones which cause obstruction always enter the gut by ulcerating their way from the gall-bladder into the duodenum. Less often they enter the hepatic flexure of the colon in the same way, but then very rarely cause obstruction. They often become added to in the gut by deposits of magnesia, or carbonate of lime. Impaction occurs in the lower ileum, or the duodenum or jejunum. Patients are generally women over fifty.
3. **Enteroliths**, or stones formed in the intestine.—These may be: (a) Phosphates, which are probably deposited from catarrhal secretions; (b) Avenoliths formed by calcareous salts and oatmeal débris; (c) Mineral deposits from medicines, e.g., magnesia, bismuth, salol, etc. Actual obstruction by any of them is very rare, and then usually occurs from impaction in the lower ileum.

Clinical Aspects of Intestinal Obstruction due to Gall-stones.—

SEX AND AGE.—Three-quarters of the patients are females, and three-quarters are over fifty.

HISTORY.—Previous attacks of biliary colic or of local peritonitis round gall-bladder.

ONSET is abrupt. **PAIN** is severe but intermittent.

VOMITING is early, incessant, copious, and often stercoraceous. **CONSTIPATION AND COLLAPSE** are in proportion to the acuteness of the attack.

The majority of cases are acute, but subacute and chronic cases occur.

UNUSUAL CASES OF GALL-STONE OBSTRUCTION.—Rarely after an acute onset, sudden relief may be caused by the stone passing the ileocaecal valve. A few weeks or months later the stone may pass the anus. Or there may be several successive attacks of subacute obstruction at varying intervals. Or the case may present all the characters of chronic obstruction, such as that due to stricture.

Clinical Aspect of Obstruction due to Other Foreign Bodies.—This is similar to that due to gall-stones, except that in the case of enteroliths the case is decidedly chronic, and often ends by the natural passage of the concretion.

Course and Prognosis.—65 per cent die. Death or recovery at about the end of a week.

Obstruction due to Foreign Bodies, *continued*.

Treatment.—The abdomen is opened in the mid-line. The bowel is incised longitudinally rather above the foreign body. The latter is removed, and the wound sewn up.

VI. STRICTURE OF THE INTESTINE.

1. **Cicatricial Stricture.**—Produced by the healing of an ulcer.

A. **INFLAMMATORY ULCERATION.**—(a) Duodenal ulcer. Very rarely causes stricture, and then the symptoms are rather those of dilated stomach. (b) Tuberculous ulcer. The strictures may be multiple; they are most often in the last part of the ileum or at the ileocaecal valve. (c) Typhoid ulcers very rarely cause stricture. (d) Syphilitic ulcers: very rare cause of stricture, except in the rectum. The ileocaecal valve may be affected. (e) Dysenteric ulcers cause stricture in the rectum, sigmoid flexure, descending colon, splenic and hepatic flexures. Taking the above all together, the large gut is affected by stricture six times as often as the small.

B. **AFTER HERNIA.**—Follows ulceration or limited gangrene of the gut due to strangulation. The symptoms follow from one month to several years after reduction. The ileum is the part generally affected.

C. **AFTER INJURY.**—This may be: (a) Surgical operations, e.g., anastomosis, when mechanical methods like Murphy's buttons are a more frequent cause than simple suture. (b) After a blow on the abdomen which has produced a partial laceration of the gut. Here adhesions generally form and help in the production of obstruction. (c) Foreign bodies, e.g., gall-stones or tooth-plates.

D. **PERIDIVERTICULITIS** (*see* Chap. XLI). A dense contracting fibrous mass is formed round diverticula of the colon which have been the seat of chronic inflammatory changes. Commonest in the pelvic colon.

2. **Cancerous Stricture** (*see also* CARCINOMA OF THE COLON, Chap. XLI).—Carcinoma is always cylindrical-celled. It may produce obstruction in various ways: (a) Most commonly by a limited annular band, like a narrow tape, tied round the gut (*Fig. 134*); (b) By a fungating mass filling up the lumen of the gut; (c) By producing a kinking; (d) Very rarely by causing an intussusception.

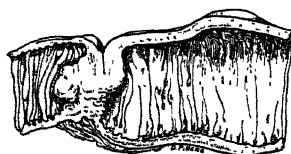


Fig. 134.—Cancer of the colon with almost complete obstruction, shown in longitudinal section. From the outside it looks as though a piece of string had been tied round the gut; hence the term 'string carcinoma'.

Dense and extreme contraction of the growth, fungation towards the lumen, ulceration at or above the growth, and colloid degeneration, may be found in the affected part. Adhesions to, or invasion of, surrounding structures may occur, but are much later and more exceptional than in malignant growths elsewhere. Metastatic growths occur in the liver, glands, and lungs, but these are late and often quite absent, even in advanced cases. Carcinoma may occur at any point, but is commonest at the sigmoid flexure, the descending colon, the splenic and hepatic flexures, and the ileocaecal valve.

3. **Congenital Strictures.**—These are all very rare compared with 1 and 2. They occur most frequently in the ileum, a few feet from the ileocaecal valve, where they may be due to an over-obliteration of the vitelline duct; then the duodenum or jejunum. They may amount to an absolute discontinuity of the gut narrowing to a fibrous cord, a membranous diaphragm, or any degree of stricture. In the colon a very few cases have been recorded. Symptoms of pyloric obstruction in the duodenal cases, or of intestinal obstruction in the others, occur in severe cases, and are fatal a few days after birth. They may remain latent for a few years or throughout life.

Locality of the Non-congenital Strictures.—The colon, and especially the sigmoid flexure, is much more commonly affected than the small gut, sixty per cent of all cases of stricture being in the sigmoid.

In the small intestine, 60 per cent are caused by cicatrization—38 per cent from ulcers, 15 per cent from hernia, 7 per cent from trauma—40 per cent by cancer.

In the large intestine (excluding the rectum), 65 per cent are caused by cancer, 35 per cent by cicatrization.

The Mechanical Conditions and Effects of a Stricture.—A stricture will not cause absolute obstruction so long as the contents of the gut at this point are fluid. Hence fatal small-gut strictures are much tighter than those in the large gut. Actual obstruction may be caused by: (1) Blocking by faecal material or fruit debris; (2) The production of kinking or volvulus.

Treatment.—

FEEDING should be by bland diet which leaves but little residue. Fruit, nuts, vegetables, etc., especially to be avoided.

APERIENTS must be used with caution. Salines are generally of most use, and in cases where the small gut is involved. They must, of course, never be used when obstruction is absolute.

OPERATION.—

FOR NON-MALIGNANT STRICTURE an enteroplasty or resection is indicated.

FOR LONG STRICTURE BURIED IN ADHESIONS a short-circuit will have to be done.

Stricture of the Intestine—Operative Treatment, *continued*.

FOR MALIGNANT STRICTURES.—EXCISION is the ideal. It ought to be preceded by a short-circuiting operation or colostomy if the patient's condition is very bad, or if great distension exists above the growth.

In inoperable growths the choice lies between A SHORT-CIRCUITING OPERATION, which should always be done if possible, and an inguinal COLOSTOMY or cæcostomy, the lumbar colostomy having been almost abandoned.

VII. OTHER NEW GROWTHS OF THE BOWEL.

These are all rare and seldom cause obstruction.

1. POLYPI may be adenomata, fibromata, fibromyomata, or submucous lipomata; rarely cystic of congenital origin. They occur most commonly in the rectum (80 per cent), and next in the ileum or colon. They are commonly multiple, and when small cause no symptoms. When they cause intestinal obstruction, this is similar to that caused by stricture. They may separate at their pedicles and pass per anum.
2. LYMPHADENOMA AND LYMPHOSARCOMA occur as submucous growths.

VIII. PRESSURE OUTSIDE THE BOWEL.

Causes.—

UTERINE.—Large retroverted uterus, especially with: Fibroids or pregnancy—Extra-uterine gestation—Pelvic cellulitis—Cancer of the uterus.

OVARIAN.—Growths of any kind, but especially solid or malignant.

VESICAL.—New growths, notably cancer; also large calculus or prostatic new growth.

MESENTERIC.—New growths, especially cysts, subperitoneal tumours, or hydatid cysts.

RENAL.—New growths. Rarely obstruction is caused by the pedicle of a movable kidney.

PANCREATIC.—Cancer, or rarely cysts.

SPLENIC.—Large and movable spleens.

HEPATIC.—New growths from the liver or bile-ducts, or glands in the portal fissure.

Regions Affected.—Rectum, 60 per cent; descending and pelvic colon, 12 per cent; lower ileum, 10 per cent; duodenum, 7 per cent; other parts, 11 per cent.

Clinical Characters.—These are of all varieties, viz., acute, intermittent, chronic, or chronic ending in acute obstruction.

IX. FÆCAL ACCUMULATION.

(See also FUNCTIONAL DISEASES OF THE COLON, Chap. XLI.)

Causes.—

1. DEFECTIVE EXPULSIVE POWER, due to some nerve condition or general debility, possibly the over-use of aperients.
2. INHIBITION OF DEFÆCATION.—Resulting from piles, fissure, or any pain in the pelvis, inflamed appendix or ovary, careless habits.
3. A LARGE QUANTITY OF INDIGESTIBLE FOOD and small quantity of liquids.
4. SOME ANATOMICAL ABNORMALITY.—Dilatation and prolapse of the cæcum, sigmoid, or transverse colon. Exaggerated sacculi. Adhesions round various parts of the colon, especially near the flexures. Thickening, contraction, and kinking by parts of the mesocolon.

Physical Characters and results on the bowel.—It occurs in the rectum, sigmoid flexure, or cæcum, in this order, or in the whole large gut. The accumulations are of two kinds: isolated masses of stony hardness from which nearly all moisture has been absorbed, and more ordinary fæcal masses. They are often covered with mucus or shreds of mucous membrane. The colon becomes dilated, elongated, and hypertrophied; it may measure 6 in. in diameter; its folds are exaggerated, and its sacculi unduly prominent. Stercoral ulcers are frequent, and may lead to perforative peritonitis.

Clinical Characters.—

COMMONER IN WOMEN THAN MEN. After middle age and in hypochondriasis.

CONSTIPATION is habitual, but attacks of spurious or catarrhal diarrhoea sometimes occur. Bowels may not act for weeks, or even months.

DIGESTIVE DISTURBANCES.—Poor appetite, offensive breath, foul tongue, eructations, flatulence, and dyspepsia.

MENTAL CHANGES.—Headache, vertigo, apathy, languor, hypochondriasis, or even insanity.

SKIN is dull, dark, greasy, and of an unpleasant odour; the conjunctivæ are dull and discoloured.

TEMPERATURE rises occasionally, especially after aperients.

ABDOMINAL DISTENSION may become marked, and produce dyspnoea and palpitation. Visible peristalsis is unusual.

PRESSURE SIGNS.—Sciatica, menstrual disturbances, cold feet, or œdema of the legs.

OBSTRUCTIVE ATTACKS, with great pain and vomiting, occur from time to time, and may prove fatal.

TUMOUR is felt in the course of the large gut, and is formed by masses of fæces. Most common situation is the cæcum, then

Fæcal Accumulation—Clinical Characters, *continued*.

the sigmoid. Very rarely it is doughy. It is often tender from stercoral ulceration.

DEATH is rare, as the cases yield to treatment; but acute obstruction, perforation, septicæmia, or cardiac failure may cause it.

Treatment.—

1. DRUGS, especially saline aperients. The more powerful cathartics usually do more harm than good.
2. LARGE DAILY ENEMATA.—(a) Soap and water; (b) Olive oil, given a pint over night and retained till next day, when it is followed by a simple enema.
3. SYSTEMATIC EXERCISE and massage where practicable.
4. APPENDICOSTOMY.—The stump of the appendix sewn into an opening in the abdominal wall. Through it the whole large gut can be thoroughly washed out daily. This lavage can be carried out by the patient.
5. ILEO-SIGMOIDOSTOMY and excision of the colon above the sigmoid, when all other remedies have failed.
6. SYMPATHECTOMY.—Excision of the lower lumbar sympathetic ganglia (*see* p. 176).

CHAPTER XL.

HERNIA.

Definition.—Protrusion of an internal viscus through an abnormal opening in the parietes.

Signs of Abdominal Hernia.—

1. **SWELLING**, generally situated in the inguinal, femoral, or umbilical region, or in site of a scar.
2. **AN IMPULSE** is imparted to this swelling on straining. The impulse is of an expansile character. The swelling is not only pushed out; it also gets larger.
3. **REPLACEMENT** can be effected into the abdomen of the contents of the hernia (unless irreducible), and this is often sudden and gurgling. When the contents of the hernia reappear, the swelling re-forms from above downwards.

NOTE.—Signs 2 and 3, which prove the connection between the contents of a swelling and the interior of the abdomen, cannot be obtained if the hernia is irreducible, and in this case the diagnosis is a matter of conjecture.

Causes.—

CONGENITAL.—Patency of the funicular process. Late descent of the testis. Weakness of the parietes, with large rings. Length of the mesentery. Congenital apertures in the linea alba. Malformation of the umbilicus or of the diaphragm.

ACQUIRED.—Violent exercise (by sudden increase in intra-abdominal pressure). Wearing tight belt, girth, or stays. Anything which causes frequent straining: Bronchitis—Large prostate—Constipation—Phimosis. Pregnancy and parturition. Fat or tumours in the abdomen. Slipping down of the mesenteric attachment. Senile atrophy of abdominal muscles.

Structure of Hernia.—

SAC.—Peritoneum pulled down through aperture. In early cases the sac can be pushed back. In established cases the sac is fixed outside the parietes.

Inflammation produces: (1) Thickening of the sac; (2) Adhesion of its contents; (3) Loculation—hour-glass contraction or hydrocele of the sac.

COVERINGS are formed by all the structures which originally cover the hernial orifice. Tend to become matted together at the hernial orifice.

Structure of Hernia, *continued*.

CONTENTS.—

SMALL INTESTINE.—Enterocoele.

OMENTUM.—Epiplocele, especially likely to become irreducible.

May develop serous cysts.

LOOSE BODIES.—From detached tags of omentum or appendices epiploicæ.

COLON OR CÆCUM.—Rare, but found in children.

BLADDER.—Either the fundus or a lateral saccule. In very large hernias.

ANY VISCUS except the pancreas may descend into a hernial sac in various conditions of enteroptosis.

INGUINAL HERNIA.

Varieties.—

1. OBLIQUE OR INDIRECT.—ACQUIRED—CONGENITAL (vaginal or funicular)—INFANTILE—INTERSTITIAL.

2. DIRECT (always acquired).—INTERNAL or EXTERNAL.

Orifice of Protrusion from the abdomen.—

OBLIQUE hernias all go through the internal abdominal ring.

External to the deep epigastric artery.

DIRECT hernias leave the abdomen internal to the deep epigastric artery, i.e., in Hesselbach's triangle, between the outer border of the rectus and the epigastric artery.

EXTERNAL DIRECT hernias leave the abdomen between the epigastric artery and the obliterated hypogastric.

INTERNAL DIRECT hernias between the hypogastric artery and outer border of the rectus.

Coverings of an inguinal hernia. From without inwards:—

OBLIQUE VARIETIES.—

1. Skin, fasciæ.

2. Intercolumnar fascia from the external oblique.

3. Cremasteric layer from the internal oblique.

4. Infundibuliform fascia from the transversalis fascia.

5. Subserous fatty tissue.

6. Peritoneum forming the sac.

EXTERNAL DIRECT hernia.—As above, except the transversalis fascia instead of the infundibuliform.

INTERNAL DIRECT hernia is covered by transversalis fascia and conjoined tendon, instead of the infundibuliform fascia and cremasteric layer.

INFANTILE HERNIA has two additional peritoneal coverings next to the sac.

Degree of an inguinal hernia.—

COMPLETE.—Emerge through the external abdominal ring and descend into the scrotum or labium.

INCOMPLETE or bubonocoele.—Lie between the internal and external rings under the aponeurosis of the external oblique.

Acquired Oblique Inguinal Hernia.—Sac formed by abdominal peritoneum. Develops slowly and is often incomplete. In early stages is above and distinct from the testis. In later stages it lies in front of the testis. Structures of the cord are spread out over the sac.

Congenital Inguinal Hernia.—Sac formed by funicular process. May arise in infancy. May arise in adolescence (in this case it forms rapidly and soon becomes complete). Commoner on the right side. Very liable to strangulation. Structures of the cord are intimately adherent to the sac.

IN FUNICULAR VARIETY.—Sac lies above and distinct from tunica vaginalis and testis (*Fig. 135, A*).

IN VAGINAL VARIETY.—Sac is continuous with the tunica vaginalis (*Fig. 135, B*). Testis is enveloped by the hernia.

Infantile Inguinal Hernia consists of an infantile hydrocele and an inguinal hernia. The funicular process is obliterated at the internal ring, but patent thence downwards, and opens into the tunica vaginalis. The hernial sac is: (1) Pushed down behind the hydrocele sac (*Fig. 135, C*); or (2) Invaginated into it—the encysted variety (*Fig. 135, D*). Thus two layers of peritoneum, with fluid between them, cover the sac.

Direct Inguinal Hernia is always acquired. Generally in late life. Caused by a laxity and weakness of the internal oblique and transversalis muscles. Comes straight through the abdominal wall. Internal and external orifices in the abdominal wall are

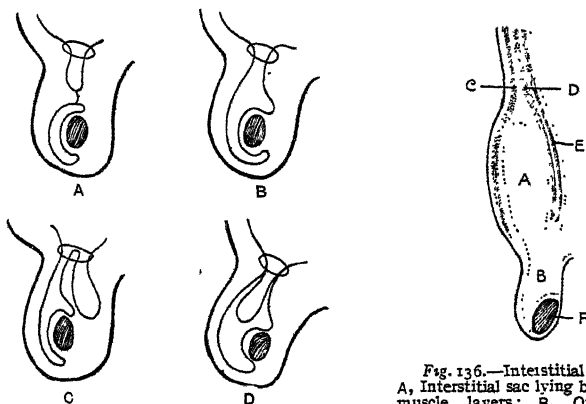


Fig. 135.—Inguinal hernia. Varieties of sac. A, Congenital funicular; B, Congenital vaginal; C, D, Two varieties of infantile (the funicular process should be shown closed at the internal abdominal ring).

Fig. 136.—Interstitial hernia. A, Interstitial sac lying between muscle layers; B, Ordinary hernial sac extending down into tunica vaginalis; C, External oblique; D, Internal oblique; E, Transversalis; F, Testicle.

Direct Inguinal Hernia, continued.

large and opposite one another. Epigastric artery runs on its outer side. Often remains small and incomplete.

Much more difficult to retain by truss or cure by operation than the oblique varieties. Because of: (1) Large size of the orifice; (2) Laxity of the abdominal muscles; (3) Directness of the descent.

The cord is distinct from and to the outer side of the sac.

Interstitial Hernia.—A congenital oblique hernia in which the sac has an extra diverticulum. This lies:—

1. Between the peritoneum and muscles in front of the bladder, or in the iliac fossa—intraperietal variety; or
2. Between the external and internal oblique muscles parallel to the outer half of Poupart's ligament—interparietal variety (*Fig. 136*); or
3. Between the muscles and skin, along the front of Poupart's ligament: generally associated with retained testis—extraperietal variety.

Especially liable to give rise to difficulty in reduction by taxis.

Signs of an uncomplicated hernia:—

ROUNDED SWELLING in the groin above Poupart's ligament or extending into the scrotum or labium.

IMPULSE on coughing or straining. The swelling comes down farther and also increases in size—expansile impulse.

CONTENTS CAN BE REDUCED into the abdomen: Upwards and outwards in indirect varieties. Directly backwards in direct varieties. Reappears from above downwards. Gurgling generally accompanies reduction.

RELATIONS.—Poupart's ligament and groin fold lie below. Pubic spine is below and on outer side in complete varieties. Inguinal canal is occupied by the sac and its contents.

Diagnosis of Incomplete Inguinal Hernia from:—

RETAINED TESTIS.—Testicular sensation on pressure. Absence of testis from the scrotum. Impulse is only pushing, not expansile. Upper limit of the swelling can be felt.

SWELLINGS OF THE CORD.—Hydrocele—Lipoma—Hæmatocele. Upper limit can often be felt. Reduction is impossible or very gradual. No expansile impulse. Traction on testis pulls the swelling down.

FEMORAL HERNIA.—In this the swelling appears first below Poupart's ligament. The inguinal canal has only the cord in it. The neck may be felt to be deep to Poupart's ligament.

ABSCCESS in the groin, especially a chronic psoas or iliac. A large intra-abdominal swelling exists. Signs of primary disease. Outline is indefinite. Fluctuation exists.

GLANDS IN THE GROIN.—Non-reducible. No expansile impulse. Tender, with indefinite outline. Primary source of infection present. Solid feeling.

Diagnosis of Complete Inguinal Hernia from :—

FEMORAL HERNIA.—Sac lies below and outside pubic spine. Reduction occurs downwards and then upwards. Distinguished by other signs mentioned above.

VARICOCELE.—Feels like a bag of worms. Does not generally extend into inguinal canal. Disappears on lying down. Reappears from below upwards.

CONGENITAL HYDROCELE.—Generally in infants. Elastic or fluctuating. Translucent. Reduction is very gradual. No impulse as a rule.

Diagnosis of Inguinal Hernia when Irreducible or Inflamed.—

WHEN INCOMPLETE :—

From GLANDULAR SWELLINGS may be impossible. Primary source of infection. Gradual development. Normal inguinal canal.

ACUTE ABSCESS, especially if it contains gas. Limits are outside the inguinal canal. Primary cause, e.g., parametritis, can be found.

WHEN COMPLETE :—

From SOLID ENLARGEMENTS OF THE TESTIS.—The cord is thick in tubercle and new growth. Enlargement is slow and gradual. Feels solid and heavy. No impulse.

Treatment of Uncomplicated Inguinal Hernia.—

TRUSSES.—

IN INFANTS.—May produce a cure in about one year. Should be rubber-covered. Should never be removed without supporting the inguinal region.

IN ADULTS.—Can only support the rupture. Will never cure the hernia.

MEASUREMENT.—Round pelvis, below crest, to meet over symphysis = size in inches.

SPRING.—Must press backwards and a little upwards. Requires renewal two or three times yearly.

ADJUSTMENT.—Only apply after hernial contents have been reduced. Pad should be over the inguinal canal and not on the bones. Leg strap is necessary to keep hernia from coming under it. May generally be left off at night.

COMMON MODIFICATIONS.—(1) Rat-tail truss: pad is produced into a tongue process attached to leg-strap. (2) Forked tongue truss: pad has two processes attaching it to leg-piece and to the cross-strap. Both useful for large scrotal hernias in which external ring is very large.

Uncomplicated Inguinal Hernia—Treatment, *continued*.

RADICAL OPERATION.—

INDICATIONS.—Healthy adults. Active occupation.

CONTRA-INDICATIONS.—Infants under one year, in whom a truss often cures. Senility. Lax atonic muscles. Enteroptosis. Existence of chronic bronchitis, enlarged prostate, any cause of straining.

DOUBTFUL CASES.—Direct inguinal hernias—because the muscles are lax or torn. Large hernias of old standing. Large irreducible hernias in old men.

METHOD.—Bassini's operation, or modification of this (*Fig. 137*).

Incision half an inch above inner half of Poupart's ligament (a curved incision turning down a flap of skin is better).

Slit up the external oblique from the external to the internal ring half an inch above Poupart's ligament.

Define the sac and separate it from the structures of the cord. Separate adhesions and remove redundant omentum. Empty the sac after opening it. Tie the neck of the sac (after transfixing it) flush with the peritoneum. Cut off the sac, and sew the stump to the deep surface of the parietes.

SEW THE ARCHED FIBRES OF THE INTERNAL OBLIQUE AND TRANSVERSALIS TO POUPART'S LIGAMENT UNDERNEATH THE SPERMATIC CORD. Sew up the external oblique and skin.

IN LARGE HERNIAS the muscles are sewn together by a strip of fascia cut from the aponeurosis of the external oblique or by a fascial graft cut from the fascia lata (*Gallie*).

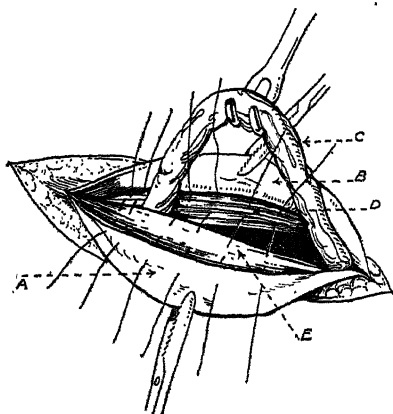


Fig. 137.—Operation for radical cure of inguinal hernia. A, Aponeurosis of external oblique, lower portion; B, Upper part of the same; C, Spermatic cord; D, Conjoined tendon, being sutured to E, Deep surface of Poupart's ligament.

FEMORAL HERNIA.

Etiology.—Before puberty both sexes equally, but rarely, affected. Commoner in women after puberty, because of the increased width of the pelvis opening out the crural canal.

Anatomy.—Emerges through the crural canal. Crural canal is innermost part of the femoral sheath. Femoral sheath is formed by the junction of: (1) The fascia transversalis in front of the vessels; (2) The fascia iliaca behind the vessels.

RELATIONS OF THE CRURAL CANAL and of the neck of a femoral hernia.—

IN FRONT.—Transverse thickened part of the femoral sheath—deep crural arch. Poupart's ligament—superficial crural arch. Iliac portion of fascia lata and cribriform fascia.

ON INNER SIDE.—Gimbernats's ligament.

ON OUTER SIDE.—Femoral vein.

BEHIND.—Os pubis and Cooper's ligament. Pectineus muscle covered by pubic portion of the fascia lata.

ABOVE it is closed by subserous tissue—the septum crurale.

BELOW it abuts against the cribriform fascia closing in the saphenous opening of the fascia lata.

COVERINGS.—

1. Skin and fascia, etc.
2. Cribriform fascia.
3. Femoral sheath (transversalis fascia).
4. Subserous tissue (septum crurale).
5. Peritoneum.

NECK.—Situated at the crural ring.

IN FRONT.—Poupart's ligament and inguinal canal with contents.

INNER SIDE.—Gimbernats's ligament.

BEHIND.—Pubic part of fascia lata covering os pubis.

OUTER SIDE.—Femoral vein.

RELATIONS TO VESSELS.—Femoral vein on outer side. Long saphenous vein enters below it. Epigastric artery to its outer side.

Obturator artery is given off as branch of the deep epigastric in one in four cases. Runs on the outer side of the sac, between it and the femoral vein, generally. Runs on the inner side of the sac by Gimbernats's ligament in one in seventy-five cases. In these only is there much danger of its division in herniotomy.

DIRECTION OF GROWTH.—After emerging from the saphenous opening, the hernia is turned upwards over Poupart's ligament by the attachment of the deep layer of the superficial fascia to the fascia lata along a horizontal line level with pubic spine.

Contents.—Small intestine (ileum)—generally. Omentum—sometimes. Large intestine when left-sided—rare. Ovary or Fallopian tube—occasionally.

Femoral Hernia, *continued*.

Signs.—Swelling below inner end of Poupart's ligament. Reducible with a gurgle. Expansile impulse on coughing. Neck lies to the outer side of and below pubic spine; lies behind Poupart's ligament and inguinal canal. When it rises above Poupart's ligament it obscures the fold of the groin, and lies superficial to the inguinal canal.

Diagnosis.—May be difficult in fat women, when hernia is irreducible. INGUINAL HERNIA and INFLAMED LYMPH-GLAND (*see above*).

LIPOMA.—Long history and stationary size.

PSOAS ABSCESS.—Relation to iliac swelling. Descends behind the femoral sheath.

SAPHENOUS VARIX.—Veins below are generally varicose. Often fills after emptying in spite of pressure over crural canal.

Treatment.—

TRUSS is less satisfactory than in inguinal hernia, because it presses on the vessels, and because the pad lies over the pubic bone, where pressure causes pain and rubbing.

OPERATION is less satisfactory because it is difficult to close the crural ring.

METHODS.—Vertical incision. Isolation of sac. Open sac and empty. Tie neck of the sac high up. Then, either:—

1. Cut through part of thickness of the pectineus muscle

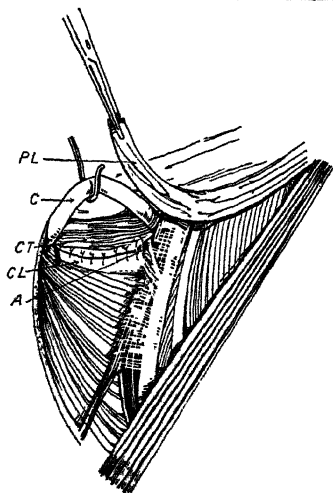


Fig. 138.—Operation for radical cure of femoral hernia. Obliteration of femoral ring and canal by suture of conjoined tendon to Cooper's ligament and pectineal fascia. P.L., Poupart's ligament; C, Cord; C.T., Conjoined tendon; C.L., Cooper's ligament; A, Junction between conjoined tendon, femoral sheath, and Cooper's ligament.

- about 2 inches below Poupart's ligament, and turn up the muscle flap so formed, and sew it to the ligament.
2. Fix Poupart's ligament to pubic bone by metal staples.
 3. Make an incision above and parallel to Poupart's ligament and separate the fibres of the external oblique aponeurosis in the line of their fibres for length of incision. The sac is withdrawn through the crural canal after separation below, ligatured as high up as possible, and excised. The conjoint tendon and internal oblique are sutured to Cooper's ligament (along the horizontal ramus of the pubis). The slit in the external oblique is then repaired.
 4. Divide pubic attachment of Poupart's ligament, proceed as in (3), and then suture Poupart's ligament over the deep line of suture. (*Fig. 138.*)

UMBILICAL HERNIA.

Varieties.—

CONGENITAL.—Hernia protrudes into base of umbilical cord. Gut may be tied and cut with the cord. Very rare.

INFANTILE.—Hernia through a stretched umbilical cicatrix. Tends to spontaneous recovery. Treated by a binder.

ACQUIRED.—Hernia through linea alba above or below the navel. Generally in stout multiparous women. Sac is very thin and lobulated. Contents, which generally include part of transverse colon and omentum, are very adherent. Much fat is developed: (1) Outside sac wall; (2) In omental contents.

Treatment.—Support by a binder or truss, or operate.

METHOD OF OPERATION.—

IN SMALL HERNIÆ.—Vertical incision. Open sac. Remove omentum and separate adhesions. Isolate and cut away sac. Cut margins of neck of sac so as to open rectal sheaths. Sew posterior sheaths of recti together. Sew recti together. Sew anterior rectal sheaths together.

IN LARGE HERNIÆ, Mayo's operation is best. A transverse incision is made around the umbilicus and hernia, and is deepened to the base of the hernia. The sac is opened at its neck, where usually no adhesions exist. The contents of the sac are reduced and the sac excised. The peritoneum is separated for a short distance around the margins of the gap in the aponeurosis and is sutured with a purse-string suture. The aponeurosis of the abdominal wall is then overlapped by mattress sutures so that one edge overlaps the other transversely by one or two inches. The edge of the superficial flap is then sutured to surface of underneath flap.

OTHER VARIETIES OF HERNIA.

Ventral Hernia.—

IN LINEA ALBA ABOVE NAVEL.—Generally a protrusion of subserous fat only. Small in size, but very painful.

TREAT by removal of fat and sewing up hole in linea alba.

IN LINEA ALBA BELOW NAVEL.—After parturition. Tends to spontaneous recovery if supported by a belt.

In bad cases only, OPERATE. Sew edge of one rectus to the deep surface of the other. Sew edge of the other rectus to the superficial surface of the first.

Post-operative.—Especially after suppurating appendicitis.

OPERATE on all young patients. Sew abdominal layers together one by one. Use of 'living fascia suture' (e.g., fascia lata) makes relapse much less likely.

PATHOLOGICAL CONDITIONS OF HERNIA.

Varieties.—

1. IRREDUCIBILITY.
2. INFLAMMATION.—Involves 1.
3. OBSTRUCTION.—Involves 1.
4. STRANGULATION.—Involves 1, 2, and 3.

I. IRREDUCIBLE HERNIA.

DEFINITION.—Contents of a hernia cannot be returned into the abdomen.

CAUSES.—

ADHESIONS OF THE CONTENTS TO THE SAC.

ADHESIONS OF THE CONTENTS TO EACH OTHER, so that a bulky mass larger than the neck of the sac is formed.

ADHESIONS OF THE WALLS OF THE SAC TO EACH OTHER, forming bands or constrictions. Follows attacks of inflammation. Occurs during obstruction and strangulation.

PRESENCE OF OMENTUM in the sac. From adhesions, fat accumulation, or cyst formation.

OCCURRENCE.—In order of frequency—in umbilical, femoral, and large scrotal herniæ.

SIGNS.—A swelling at one of the hernial orifices. Gurgling may be felt and heard. Portion of the contents can often be reduced.

DIAGNOSIS.—From the following (*see above*): Inflamed glands—Lipoma of parietes or cord—Abscess (e.g., psoas abscess).

DANGERS.—Obstruction—Strangulation.

TREATMENT.—

FIRM PRESSURE.—In bed, by bandages and ice-bags. By a special truss—the hinged-cup truss.

OPERATION for radical cure.

Contra-indications for operation: Old patients with no symptoms. Very large hernia.

SUPPORT by a bag truss.

II. INFLAMMATION OF A HERNIA.

DEFINITION.—Inflammation of the peritoneal sac and of the contents of a hernia.

CAUSES.—Injury, e.g., by taxis. Escape of bacteria through the gut wall. Strangulation.

ANATOMY.—An exudation from the sac wall and from the peritoneum covering the contents. Nature of the exudation is serous, plastic, or purulent.

SIGNS.—Those of external inflammation. Heat, redness, tenderness, and oedema over the hernia. Hernia is irreducible. Temperature rises. Some constipation and vomiting.

RESULTS.—Abscess forms and bursts externally. Strangulation may supervene. Irreducibility generally remains.

TREATMENT.—Rest in bed, with fomentations. Incision and drainage if suppuration occurs. Radical operation cannot be done until the septic inflammation is over.

III. OBSTRUCTION OF A HERNIA.

DEFINITION.—Lumen of the gut in a hernia is obstructed without strangulation of its coats.

CAUSES.—Presence of solid matter in the gut. Specially liable to occur in umbilical hernia, which often contains the transverse colon. Complicated matting together of the gut interferes with its peristaltic action.

SYMPTOMS.—The hernia is irreducible and larger than usual. Constipation, vomiting, and colicky pains—occurring together in attacks lasting several hours or days.

RESULTS.—Recovery from early attacks as a rule. Strangulation ends an attack ultimately.

TREATMENT.—Rest in bed with low diet. Pressure and an ice-bag over the hernia. Copious enemata. Radical cure when the obstruction is over.

IV. STRANGULATED HERNIA.

DEFINITION.—Constriction of the contents of a hernia to such a degree as to stop the circulation in them.

Strangulated Hernia, continued.**CAUSES.—**

- a. **EXISTENCE OF A TIGHT STRANGULATING BAND** of constriction. The neck of the sac itself in congenital inguinal cases. The matted tissues at the internal abdominal ring in acquired inguinal cases. Gimbernat's ligament in femoral cases. Bands of adhesion inside the sac.
- b. **THE FORCING DOWN OF AN EXTRA PORTION** of the viscera through the neck of the sac.
- c. **ADHESIONS AND KINKING** of coils of gut resulting from inflammation.

PATHOLOGY.—**a. THE GUT.—**

FIRST STAGE.—Stasis of the circulation, with venous engorgement. Colour is dark red or purple. Great thickening of the gut wall from oedema. Distension of the lumen by gas. Escape of bacteria, viz., the staphylococcus and *Bacillus coli*, through the gut wall. Small ecchymoses may occur. Peritoneum is smooth and shiny. Vessels can be emptied by pressure and refill easily.

SECOND STAGE.—Thrombosis. Peritoneum is covered by plastic lymph and has lost its lustre. Colour is a dark purple. Vessels cannot be emptied by pressure. Free passage of bacteria through the gut wall.

THIRD STAGE.—Gangrene. Gut is a slate-grey or black. May be perforated, or gives way on handling.

AT THE SITE OF STRANGULATION.—A pressure ulcer occurs from the mucous surface, or the whole thickness of the gut sloughs at the point of greatest pressure. Bacteria escape through this. Perforation may occur before, during, or after reduction.

ABOVE THE STRANGULATION.—Distension of the gut from obstruction. Paralysis and peritonitis occur later if the condition has long continued.

- b. **OMENTUM.**—Undergoes similar changes, but gangrene is much rarer.
- c. **SAC.**—Undergoes the changes of peritonitis. Inflammation, with copious serous exudation. Exudation becomes blood-stained and offensive. Plastic lymph may be deposited on its surface. Sloughing from the virulence of bacterial action. Inflammation heralded by oedema of tissue outside the sac. Sac bursts and a fæcal fistula results.

Anatomical Varieties of Strangulated Hernia.—

SIMPLE ENTEROCELE.—The common form.

EPIPOCELE.—Rarely strangulated unless bowel occurs in the hernia also.

PARTIAL ENTEROCELE (Richter's Hernia).—A part only of the circumference of a piece of gut is strangulated.

HERNIA OF DIVERTICULUM (Littre's Hernia).—A blind diverticulum only is strangulated, e.g., the appendix or Meckel's diverticulum.

Signs.—

AT FIRST.—The hernia becomes hard or feels tense. Irreducible. No impulse on coughing. Tender or painful. History of recent enlargement.

LATER.—Skin becomes inflamed and oedematous. Dark colour with emphysema if patient survives.

THE ABDOMEN.—Severe spasmodic pain referred to the navel. Tenderness and rigidity markedly absent at first. Distension and tympanites (from meteorism). Signs of peritonitis occur late.

Symptoms.—

SHOCK.—

MOST MARKED IN: Pure enterocele—Partial enterocele (Richter's hernia)—When a hernia becomes strangulated on its first occurrence (children, congenital cases).

LEAST MARKED IN: Old-standing cases—Large herniæ—Cases preceded by irreducibility and inflammation—Epiplocele.

Pulse slow and weak, then rapid and irregular. Temperature subnormal, but rising with onset of inflammation. Faintness.

PAIN.—Referred to the region of the umbilicus. Also over the region of the hernia. Occurs as spasms of colic supervening on a constant abdominal pain. Becomes less on the onset of gangrene.

VOMITING.—First of food. Later of bile and small intestine contents. Lastly of foul stercoraceous fluid.

CONSTIPATION.—Absolute from the first in most cases. Caused by: (a) Obstruction of the lumen of the gut; (b) Paralysis of the gut by nerve shock; (c) Peritonitis (at last).

Not present at first: In strangulation of the gut high up, when the lower bowel may empty itself.

Not present at all: In epiplocele, or any case when a viscus (e.g., ovary) other than gut forms the contents of the hernia. In partial enterocele (rare).

TOXÆMIA.—Occurs after the case has persisted some time. Shrunken face, hollow eyes, anxious expression. Temperature becomes again subnormal. Drowsiness, delirium, and coma.

LATENCY OF THE SYMPTOMS is often well marked and very important. Occurs especially in elderly patients, and in old-standing hernias. Shock may be absent entirely. Only symptoms present may be constipation, a little vomiting, and local tenderness over the hernia.

Gangrene of the gut in such cases may be signified by: Relief of pain in the abdomen. Relief of tension and tenderness in the hernia. Occurrence of œdema over the hernia.

N.B.—Gangrene of the gut may occur within a few hours of strangulation.

Strangulated Hernia, *continued*.

Treatment.—

TAXIS.—Should be used in the following conditions only :—

1. When the hernia has only just appeared, e.g., in congenital hernia, when the contents come down suddenly and are at once strangulated.
2. When the hernia has been reducible a short time previously.
3. Within a few hours of the onset of strangulation.
4. For a short time (ten minutes).
5. With the utmost gentleness.
6. Under an anæsthetic, which may be prolonged for the operation of herniotomy.

DANGERS.—Except in the cases mentioned above, taxis is much more dangerous than operation, and is often the cause of a fatal result following an operation.

1. *It may damage the sac and its contents*, especially the gut. Causes œdema and swelling. Produces hæmorrhage into the sac and into the gut wall. May rupture the gut.
2. *It may force inflamed or gangrenous gut back into the abdomen*. Hastens the transudation of bacteria through the gut wall. Hastens gangrene. Causes unnecessary suffering and delay. Makes the subsequent operation more difficult and dangerous.
3. *It may reduce the hernia without relieving symptoms* :—
 - a. By the reduction of a ruptured or gangrenous gut.
 - b. By causing peritonitis from the reduction of septic contents into the abdomen.
 - c. By forcing the sac with its strangulated contents back into the abdomen—'*réduction en masse*'.
 - d. By forcing the hernial contents into a pouch leading out of the main sac, such as occurs in an interstitial hernia—'*réduction en bissac*'.
 - e. By forcing the contents through a rupture in the neck of the sac.
 - f. By reducing contents whose strangulation is due, not to the neck of the sac, but to a band or kinking of the contents themselves.

OPERATION without any unnecessary delay. Directly the diagnosis is clear or even probable. In all except the few cases when taxis is permissible and successful.

DANGERS OF DELAY IN OPERATION.—

No tendency to natural recovery, except the very rare occurrence of a natural fæcal fistula.

Sepsis begins to occur with strangulation, by an escape of bacteria through the congested gut.

Gangrene of the gut may result in a few hours.

Paralysis of the gut, with incapacity for recovery, may result from prolonged distension.

The general condition of the patient becomes worse and not better from delay, because of: (1) Want of food; (2) Want of sleep; (3) Loss of fluid by vomiting; (4) Rapidly increasing septic absorption.

Operation for Relief of Strangulated Hernia.—

PRELIMINARIES.—Wash out the stomach if vomiting is severe.

Or anæsthetize by local, spinal, or intratracheal anæsthesia.

EXPOSURE OF HERNIAL CONTENTS.—Cut down to the sac.

Open sac carefully and let out contained fluid.

DIVISION OF THE STRANGULATING AGENT.—Usually found at the neck of the sac. Occasionally in the body of the sac or in the contents. In oblique inguinal herniæ, cut upwards and inwards at the neck of the sac. In femoral hernia, cut inwards Gimbernat's ligament. In all others, cut any tense band that may be felt. Make the incision as small as possible: just sufficient to free the contents.

EXAMINATION OF CONTENTS.—First pull the contents down farther, so that the actual site of strangulation can be examined. Decide whether the contents, especially the gut, are viable.

SIGNS OF VIABILITY of the gut or other viscus.—The peritoneum is smooth and shiny. Blood-vessels can be emptied by pressure, and refill.

SIGNS OF THE GUT NOT BEING VIABLE.—The peritoneum has lost its lustre. May be covered by lymph. Colour is deep purple or slate. Vessels cannot be emptied by pressure.

TREATMENT OF THE GUT and other hernial contents.—

ANY LIMITED ULCER at the site of strangulation, or

ANY LIMITED PATCH OF GANGRENE, should be infolded by sewing the neighbouring healthy gut over it.

VIABLE GUT should be returned into the abdomen.

REDUNDANT OMENTUM should be ligatured and removed.

NON-VIABLE GUT should be excised, cutting well above and below the site of strangulation. Then perform immediate anastomosis of the healthy ends, except in the following: (1) When great distension exists, or (2) when the patient's condition is desperate, sew the ends together in part of their circumference, and tie in a tube at the remaining part, pushing the junction just within the abdomen.

RADICAL CURE should complete the operation, except when the patient's condition is grave, or when gangrene and sepsis are evident. In this case drain through the opening in the parietes.

AFTER-TREATMENT.—Enemata of turpentine and soap until natural evacuations occur. Continuous rectal infusion of saline fluid in cases with marked collapse or peritonitis. Avoid feeding by mouth until the bowels have acted.

Complications after Operation.—Intestinal obstruction from paralysis of the gut. Peritonitis. Acute enteritis, passage of blood and mucus.

CHAPTER XLI.

DISEASES OF THE COLON.**Anatomy and Physiology of the Colon.—**

LENGTH OF LARGE INTESTINE.—Five feet in adults, i.e., $\frac{1}{3}$ of the whole intestine, and about the same length as the individual's body height.

SUBDIVISIONS OF COLON :—

NAME	BEGINS	ENDS	LENGTH	CIRCUMFERENCE
Cæcum	Blind End	Ileocæcal Valve	7 cm.	28 cm.
Ascending Colon	Ileocæcal Valve	Liver	10 „	20 „
Hepatic Flexure	Liver	Liver		
Transverse Colon	Liver	Spleen	50 „	15 „
Splenic Flexure . .	Spleen	Spleen		
Descending Colon	Spleen	Left Iliac Crest	15 „	14 „
Iliac Colon . .	Left Iliac Crest	Left Psoas	10 „	
Pelvic Colon . .	Left Psoas	3rd Sacral Vertebra	50 „	17 „

These figures vary very much, especially as regards the transverse and pelvic colon.

CAPACITY OF LARGE INTESTINE.—In adults it holds 3 to 5 pints (2 to 3 litres), i.e., about the same capacity as the whole of the small intestine.

SPECIAL CHARACTERS OF THE COLON.—(1) The outer longitudinal muscle is arranged as three distinct bands or *tæniæ*. This becomes rearranged as two bands at the lower part of the pelvic colon. (2) The sacculations which bulge out between the *tænia*. (3) The appendices epiploicæ. Fatty appendages which are best marked in fat subjects, in old age, and in the transverse and pelvic colon.

COMMON VARIATIONS.—

THE CÆCUM MAY HAVE THE APPENDIX: (1) Abruptly demarcated and attached behind and to the inner side—the adult type; (2) Abruptly demarcated and terminal—the infantile type; or (3) Terminal with no sharp demarcation—the foetal type.

POSITION OF THE CÆCUM.—(1) Normally in the right inguinal region; Often (2) in the right loin close under the liver, (3) hanging over the pelvic brim or actually in the true pelvis; Rarely (4) behind the umbilicus, or (5) in left iliac fossa.

THE HEPATIC FLEXURE may be absent, the ascending running obliquely into the transverse colon.

THE TRANSVERSE COLON varies much in length and position, When very long its middle part may lie in the pelvis.

PELVIC COLON varies : (1) In length—from 12 cm. to 84 cm. ; (2) In position—commonly lying in the pelvis, more rarely as a loop upwardly directed across the abdomen ; (3) In the length of mesentery—the pelvic mesocolon may be absent, or be anything up to 25 cm. long.

CONSTRICTIONS.—

SPLENIC FLEXURE is so much kinked by the attachment of the phrenico-colic ligament as to be the narrowest point.

RECTOCOLIC JUNCTION.—There is often an abrupt angle where the pelvic colon passes into the rectum, and at this point a thickening of the circular muscle forms a kind of sphincter.

THE ILEOCÆCAL VALVE forms a muscular sphincter under nervous and reflex control, which regulates the admission of chyme from small gut into large. As a mechanical valve it is incompetent ; fluid can be forced by enemata into ileum.

TIME OCCUPIED BY CONTENTS IN PASSAGE OF INTESTINES.—

Small intestine, 4 hours ; ascending colon, 1-3 hours ; transverse colon, 2 hours ; descending and pelvic colon, 16 hours.

MOVEMENTS OF THE COLON.—

PERISTALSIS, as in the small bowel, drives on the intestinal contents towards the anus.

ANTIPERISTALSIS is probably a normal movement in the proximal part of the colon, and it tends to drive the fluid contents of the transverse and ascending colon back towards the cæcum. In certain conditions this antiperistaltic contraction is probably exaggerated.

DIGESTION IN THE COLON.—

WATER ABSORPTION.—The colon is capable of absorbing an unlimited quantity of water. Normally it absorbs about 16 per cent of the water from the chyme of the small intestine. This is its principal function.

FOOD ABSORPTION.—Proteins, fats, and carbohydrates are absorbed in such small quantities as to be negligible. When injected into the rectum, emulsified fat and carbohydrates are absorbed to some extent, and proteins very slightly.

PUTREFACTION.—Proteins and fats are decomposed and carbohydrates undergo fermentation in the colon under the influence of the bacteria.

BACTERIA IN THE INTESTINES.—

THE DUODENUM AND JEJUNUM are almost germ-free, and if the mouth and food are sterilized they may be kept so.

THE ILEUM contains an increasing number of bacteria towards its lower part.

THE CÆCUM contains the maximum number and variety of bacteria. It is rightly called the intestinal cesspool—into it the fluid contents of both small and large guts are emptied.

THE COLON contains many varieties both of bacilli and cocci. The *Bacillus coli* and the pyogenic cocci predominate. About one-third part by weight of dried fæces consists of bacteria.

FUNCTIONAL DISEASES OF THE COLON.

There are many cases of extreme constipation unassociated with any gross disease of the colon; there are others—comparatively rare—in which the colon is lengthened, kinked, or dilated, as a primary congenital defect; and lastly, there are cases in which constipation and dilatation of the colon occur and increase *pari passu*, the one condition sometimes being the cause and sometimes the result of the other. For purposes of description it will be convenient to take the extreme type of idiopathic dilatation of the colon, although this is the rarest.

IDIOPATHIC DILATATION OF THE COLON.

(*Hirschsprung's Disease.*)

Etiology.—

SEX.—Males always are more liable than females, and this is more marked in infancy than adult life. In infants, males: females :: 8:1. In adults, males: females :: 2:1.

AGE.—The majority occur in infants or children under 10, and in adults most cases are over 40.

CAUSE.—Congenital malformation of the colon probably accounts for the majority. In others, long-standing constipation may be the cause and the colonic dilatation the result. Over-action of the sympathetic nervous system.

Pathological Anatomy.—

PARTS AFFECTED.—The pelvic colon is alone affected in nearly 30 per cent, and with other parts in more than 60 per cent. The whole colon is uniformly dilated in about 15 per cent.

MEASUREMENTS.—An increase in length is frequent, but not invariable, and is less often found in the very young children than in those of older years. The girth is dilated so that the circumference is often as great as that of the patient's thigh (14 in. in infants, 24 in. in adults). The capacity is correspondingly increased, being as much as 7 pints in infants and up to 20 pints in adults.

KINKING is necessitated in order to accommodate the voluminous gut. This is best marked in the transverse and pelvic portion, and especially at the junction of the colon and rectum.

MUSCULAR HYPERTROPHY.—The muscular wall is usually much thickened, and occasionally a long or short segment of the colon is tightly contracted. A thickness of 6 mm., or three times the normal, is common.

INFLAMMATORY changes in the peritoneum are conspicuously absent. Stercoral ulcers may occur in the lumen and lead to perforation.

SECONDARY OR PRESSURE CHANGES.—Venous obstruction, with edema of the legs. Scanty, albuminous urine. Diaphragm, heart, and lungs pushed upwards.

Physical Signs.—

ABDOMEN is distended and globular, tympanitic to percussion, and showing no free fluid.

VISIBLE PERISTALSIS.—Large coils of colon are disposed chiefly in a longitudinal direction, and these contract visibly and audibly.

CHEST is contracted and short, being only $\frac{1}{2}$ or $\frac{1}{3}$ the length of the trunk, instead of the normal $\frac{2}{3}$. The lower rib margins are everted.

Symptoms.—

ONSET.—Gradual, being preceded by a variable latent period.

CONSTIPATION.—Varies very much. Usually it is conspicuous, the intervals between going to stool varying from one week to three months. Some, however, have regular daily motions, but this does not imply that there is no intestinal stasis.

DIARRHŒA may alternate with constipation and afford temporary relief to the distension.

EMACIATION WITH LOSS OF APPETITE occurs sooner or later in severe cases, and indicates that treatment must be undertaken without delay.

NERVOUS SYSTEM.—In infants convulsions or tetany, in adults neurasthenia or melancholia.

CAUSES OF DEATH.—Perforative peritonitis—Bronchitis or bronchopneumonia—Convulsions—Toxæmia.

COURSE.—The length of the disease varies from a few weeks to many years. The earlier the symptoms manifest themselves the more rapid is the course of the case.

Cases in Adults in which Constipation is the Primary Factor differ from the above-described cases of idiopathic dilatation of the colon in the following respects :—

PARTS AFFECTED.—The upper part of the colon, i.e., the cæcum and ascending and transverse portions, is most frequently involved, whereas in the congenital or idiopathic variety it is the pelvic colon.

SEX.—Females greatly preponderate over males, in a proportion of 5 or 7 to 1, just the inverse proportion to that obtaining in the congenital disease.

SYMPTOMS.—Constipation does not date from early life; distension of the abdomen is not marked, and visible peristalsis is not seen.

Treatment.—

DIET.—Easily digested food—milk, fish, eggs, and farinaceous food. Some cases react better to a coarse diet of brown bread, porridge, and vegetables, but such are exceptional.

DRUGS.—Ordinary purgatives are worse than useless, especially when great distension exists. Tonics and stimulants, e.g., strychnine, aloes, and iron, may be of some use in conjunction with enemata, etc.

Idiopathic Dilatation of the Colon—Treatment, *continued*

ENEMATA.—Whilst it is easy to inject large quantities of fluid per rectum, this may be retained or returned unchanged. Olive oil (1 pint) given at night (and retained), followed by turpentine (1 oz.) in soapy water in the morning, is the most efficacious. An electric current of 50 milliamperes may be used in conjunction with a simple enema. The positive pole is formed by the metal rectal tube, the negative by a pad over the colon.

MECHANICAL MEANS.—Athletic exercises, abdominal massage, and electrical treatment will benefit the cases of slight degree. Defæcation should be performed in the squatting position, and tight corsets abandoned.

SURGICAL TREATMENT.

INDICATIONS.—Failure of diet, drugs, and enemata to afford permanent relief. Marked and increasing distension of abdomen. Visible intestinal peristalsis. Progressive emaciation.

MECHANICAL EMPTYING OF THE BOWEL.—In some cases the colon has been emptied through an incision, which was then closed. By careful dieting and enemata further operation has been unnecessary.

ARTIFICIAL ANUS.—A cæcostomy or colostomy will afford temporary relief.

SHORT-CIRCUITING OPERATIONS.—(1) The ileum to the pelvic colon. (2) One part of the colon to another, especially the two limbs of a large pelvic loop.

EXCISION.—Removal of the whole colon or of the affected part has given the best result. The danger of the operation is much diminished by a preliminary ileosigmoidostomy.

APPENDICOSTOMY.—The appendix is removed and its stump fixed in the parietal wound. Through this the whole colon can be washed out daily. This is adapted for the lesser grades of disease.

SYMPATHECTOMY.—Excision of the lumbar ganglia (*see* p. 176).

COLITIS.**Classification of Inflammatory Diseases of the Colon.**

1. CATARRHAL COLITIS.
2. MUCOMEMBRANOUS COLITIS.
3. ULCERATIVE COLITIS.—
 - a. SIMPLE.—Follicular, stercoral.
 - b. NECROTIC.—Embolic, thrombotic.
 - c. ACUTE INFECTIVE.—Typhoid, dysentery.
 - d. CHRONIC INFECTIVE.—Tubercle, syphilis.
 - e. CONSTITUTIONAL.—Gout, scurvy, leukæmia.
 - f. TOXIC.—Uræmia, mercury.
4. COLITIS POLYPOSA.
5. PERICOLITIS.—SIGMOIDITIS—DIVERTICULITIS.

Catarrhal Colitis.—Colicky pains, constipation, and the passage of mucus are the chief symptoms. It is important to note that the passage of mucus may occur in simple catarrh, and is by itself no evidence of gross organic disease.

IN CATARRH OF THE SMALL INTESTINE the mucus is intimately mixed with the fæces, and free bile pigment is present. There is a marked acid reaction.

IN CATARRH OF THE LOWER COLON the mucus is present in shreds and flakes upon the outer surface of the fæces.

Mucocomembranous Colitis.—The formation and passage of excessive mucus from the colon without any structural change in its wall.

ETIOLOGY.—

SEX.—Women in over 80 per cent.

AGE.—Between 20 and 40 in over 60 per cent.

NEUROSIS.—In almost all the patients there is well-marked neurasthenia, and any emotional disturbance is likely to be followed by an exacerbation of the disease.

GOUT and the allied conditions of lithiasis and arthritis are often associated with it. About 10 per cent pass intestinal sand.

SYMPTOMS.—

Mucus is passed generally without mixture with fæces, in the form of long shreds or tubes. These tubes are not really membranous, but simply mucous casts of the colon in which a few cells may be entangled.

PAIN is well marked and is paroxysmal in character, chiefly in the left iliac fossa. Attacks of colic precede and accompany the passage of mucus.

CONSTIPATION is obstinate and constant, even when the colic and passage of mucus are present.

SYMPTOMS OF ULCERATION, viz., passage of blood and pus, supervene in some cases. Leads to rapid emaciation.

TREATMENT.—

GENERAL treatment appropriate to neurasthenia.

DIET.—Coarse food, e.g., brown bread, porridge, vegetables, and fruit, to overcome the constipation.

APERIENTS usually increase the pain without curing the constipation.

LAVAGE.—Systematic irrigation of the colon with large quantities of hot water constitutes the Plombières system. It is satisfactory for a time, but relapses are usual.

SURGICAL TREATMENT (*see* p. 500).

Ulcerative Colitis.—

CAUSES.—

DYSENTERY.—In the tropical form, a protozoan amœba. In the epidemic or asylum dysentery, Shiga's bacillus (probably a variety of *Bacillus coli*).

CATARRHAL, FOLLICULAR, AND STERCORAL ULCERS arise in any condition of constipation or colitis.

Ulcerative Colitis, *continued*.

PATHOLOGY.—

THE SIMPLE ULCERS occur usually in the pelvic colon, or at the flexures, or in the cæcum. They are solitary, and destroy the mucous and muscular coats, without producing much thickening of the peritoneum. Therefore they are liable to cause acute perforation. Rarely their healing leads to stenosis.

THE INFECTIVE OR DYSENTERIC ULCERS may affect the whole colon. More commonly they are localized: (1) In the cæcum and ascending colon; or (2) In the pelvic colon and rectum. Large areas of mucous membrane are destroyed, leaving ragged irregular ulcers. In the chronic forms the gut becomes rigid and thickened and matted in adhesions.

SYMPTOMS.—

IN SIMPLE OR SOLITARY ULCERS the symptoms are merely those of catarrhal colitis. Perforation is apt to occur suddenly, with almost invariably fatal consequences.

IN THE MORE DIFFUSE FORMS OF ULCERATION the following occur:—

Diarrhœa is severe and persistent, especially when the rectum and pelvic colon are affected.

Pain with tenesmus is similarly more severe when the lower bowel is affected.

Mucus, blood, and pus constitute the greater part of the loose stools. The association of pus with blood and mucus is the proof of active ulceration.

Tenderness along the course of the colon is specially indicative of peritoneal involvement.

Loss of flesh may become extreme. It is caused chiefly by toxic absorption, and is an important indication for surgical treatment.

MEDICAL TREATMENT consists in rest, warmth, milk diet, and rectal lavage, but this only cures a minority of the acute cases. The chronic cases are extremely resistant to treatment, and suffer from constant relapses.

SURGICAL TREATMENT.—

COLOSTOMY, whether performed in either inguinal or lumbar region, has given good results, which are due to the free drainage which it brings about. A right inguinal colostomy is probably the most efficacious, because it diverts the fæces from the colon below. The artificial anus is kept open for six to twelve months, and then closed by a plastic operation.

APPENDICOSTOMY is suitable for the less severe type of case. If it fails, one of the more radical operations can be performed later. The appendix is brought through a small parietal wound and removed, all but the proximal $\frac{1}{4}$ inch. This is fixed open in the wound, and through it the whole colon is irrigated daily. The circular muscle at the base of the appendix serves as a sphincter which prevents fæcal discharge. The patient soon learns to carry out the lavage at

home. The appendicostomy can be closed (generally in one year's time) by the application of the actual cautery to the mucous membrane.

ILEOSIGMOIDOSTOMY is suitable only for cases in which the pelvic colon and rectum are healthy, and in which appendicostomy or colostomy has failed to effect a cure.

Colitis Polyposa (Multiple Polypi of the Colon).—Multiple polypi may occur in any part of the large intestine. They frequently extend from the cæcum to the rectum, numbering many thousands.

The common age is between 20 and 40, and they give rise to diarrhoea and the passage of blood-stained mucus. There is pain and loss of weight.

X-ray examination of the colon after a barium enema will demonstrate the polypi.

TREATMENT.—Resection of the affected portion is the only satisfactory treatment, as one or more of the polypi eventually undergo malignant change.

PERICOLITIS: DIVERTICULA: DIVERTICULITIS: AFFECTIONS OF APPENDICES EPIPLOICÆ.

Diverticula may occur in any part of the alimentary tract, and may be congenital or acquired. The congenital diverticula are found principally in the duodenum and jejunum or as a Meckel's diverticulum. The acquired diverticula are limited to the colon, and the inflammatory condition associated with these is named diverticulitis.

Diverticula of the Colon: Diverticulitis.—

ANATOMY.—

SITUATION.—Comparatively common in the descending and pelvic colon. Rare in rest of the colon. Always cease at the rectum. Bulge out from the outer and inner borders of the gut, often projecting into the appendices epiploicæ (*Fig. 139*).

NUMBER AND SIZE.—Usually multiple, and may be as many as 400. Commonly about the size of currants, they may vary from a pin's head to a grape.

STRUCTURE.—Consist in a hernial protrusion of mucous membrane through the thinned muscular wall of the gut. This is specially liable to occur where a blood-vessel pierces the wall to enter a fat appendix. They often contain faecal material, which may be inspissated to form a concretion. Rarely they lodge a foreign body.

ETIOLOGY.—Diverticula are caused either by increased pressure within the gut ('pulsion' diverticula), or by the dragging of a structure adherent to the outer coats of the gut ('traction' diverticula).

SEX AND AGE.—Men are more liable than women. They never occur before 20. Usually the age is about 60.

Diverticulitis—Etiology, continued.

OBSITY is usually present, and there is much fat in the abdomen and appendices epiploicæ.

CONSTIPATION is the most important factor in their development. They indicate that muscular hypertrophy of the colon is yielding to dilatation. They are thus similar to the saccules which occur in the bladder of an old man with a large prostate.

SECONDARY PATHOLOGICAL CHANGES.—Once formed, a colic diverticulum forms a miniature appendix vermiformis, and is liable to the same pathological changes.

GENERAL PERITONITIS from perforation of, or a transudation of bacteria through, a diverticulum. The pouch may be in a condition of **GANGRENOUS DIVERTICULITIS**.

LOCAL ABSCESS in the left iliac fossa, exactly resembling an appendicitis abscess.

CHRONIC INFLAMMATION.—A proliferative chronic inflammation occurs in the walls of the colon round the diverticulum; in the end this condition converts the gut into a thick, rigid, stenosed tube, exactly resembling some forms of scirrhus cancer.

ADHESIONS TO OTHER VISCERA.—Especially the small intestine and bladder. In the former case acute obstruction, and in the latter a vesico-colic fistula (*Fig. 139*), with the passage of flatus per urethram (pneumaturia), may result.

CARCINOMA may supervene upon the condition of chronic inflammation.

SYMPTOMS.—

LATENCY.—Diverticula often occur without causing any symptoms at all.

CLINICAL GROUPS.—The following clinical groups may be recognized :—

1. *Inflammatory.*—In this group the patient suffers from recurring attacks of greater or less severity, in which localized pain, tenderness, rigidity, and swelling are present. Temporary intestinal difficulty accompanied by vomiting may be observed. The symptoms are so similar to those caused by inflammation of the appendix that 'left-sided appendicitis' is spoken of in many instances. In the graver form an acute general peritonitis is found, and at operation a perforated diverticulum is disclosed.
2. *Obstructive.*—Chronic intestinal difficulty, with periodic attacks of exaggerated difficulty amounting to temporary obstruction, is not infrequent; in the severer cases a complete intestinal obstruction may be present.
3. *Fistulous.*—The passage of faecal matter and air by the urethra indicates that a communication exists between the intestine and bladder (*Fig. 139*). The opening

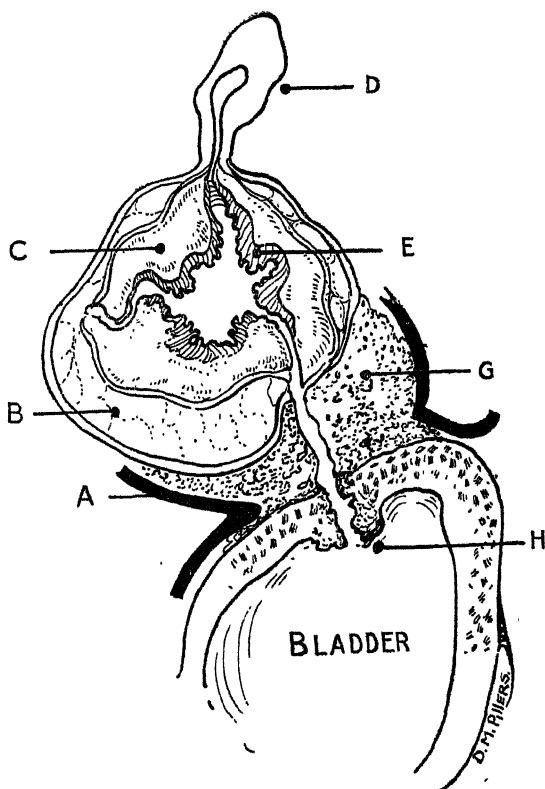


Fig. 139.—Diagrammatic representation of diverticulitis. Above is the colon and below the bladder, both in section. A, Thickened peritoneum; B, Thickened indurated wall of colon, resembling scirrhus cancer; C, Thickening of the submucous layer; D, Diverticulum extending outwards into an appendix epiploica; E, Mucous membrane; G, Inflammatory material between colon and bladder; H, Perforation into bladder.

Diverticulitis—Symptoms, *continued*.

may be seen with a cystoscope. The cause is almost invariably a diverticulitis of the sigmoid flexure.

4. *Pelvic*.—An inflammatory mass is found in the pelvis, and in the female is attributed to disease of the adnexa. The symptoms are often similar to those of salpingitis and pyosalpinx.

DIFFERENTIAL DIAGNOSIS.—In cases where a tumour has formed there may be the greatest difficulty in distinguishing between carcinoma and diverticulitis. In carcinoma hæmorrhage occurs more frequently than in diverticulitis, and the discharge of mucus is more abundant. The duration of the intestinal difficulty in cases of diverticulitis may extend over years, the disease often progressing very slowly. Pelvic conditions in the female may closely resemble diverticulitis, but an X-ray examination makes the diagnosis obvious.

TREATMENT.—

MEDICINAL TREATMENT.—The restriction of a diet having heavy residue and the administration of aperients causing fluid actions daily may check the progress of the disease and prevent its complications. In advanced cases where a tumour has formed, stenosis occurred, or fistulæ developed, surgical treatment will be necessary. The difficulty of surgical treatment, in certain cases, may lie in the extensive character of the disease, the colon from the hepatic flexure to the rectum being involved.

SURGICAL TREATMENT.—Very difficult, owing to the fact that the lesions are extensive.

1. *Acute*.—

- a. Excise and bury, as for appendix.
- b. If diverticulum cannot be found, bring colon out of wound and drain until obstruction subsides. Then excise diverticulum or do a lateral anastomosis. Always get large gut well washed out.
- c. Wrap omentum around colon, failing other methods.
- d. Excision of the affected region.

2. *Chronic*.—

- a. Drainage above, then excise after.
- b. Short circuit, if (a) not possible, by putting transverse colon into sigmoid colon below disease.
- c. Colostomy.
- d. Resection is usually not possible.

Chronic Sigmoiditis is a localized thickening of the pelvic colon associated with stenosis.

CAUSES.—Diverticulitis (*see above*). Cicatrization of a simple or stercoral ulcer.

SYMPTOMS.—Chronic intestinal obstruction of slow onset, associated usually with a sausage-shaped tumour in the left inguinal region.

TREATMENT.—In the early stages, a milk diet with copious oil enemata may relieve. Later, colostomy or excision of the affected part.

Morbid Conditions associated with the Appendices Epiploicæ.—

1. **ASSOCIATION WITH DIVERTICULA** (*see above*).
2. **TORSION.**—This results in the pedicle becoming twisted and narrow. Symptoms of recurrent colic.
SEPARATION of the appendix may result, thus producing a fatty tumour free in the peritoneal cavity.
INFLAMMATION may occur, with symptoms of subacute peritonitis.
3. **INTESTINAL OBSTRUCTION** may be caused by an inflamed and adherent appendix epiploica forming a band which strangulates a loop of small intestine.
4. **STRANGULATION IN HERNIAL SACS.**—Long pendulous appendices may be part of or the sole contents of a hernia. Strangulation of the hernia may cause gangrene of the fatty processes. It may happen in femoral or inguinal herniæ in either sex or on either side, but the left side, femoral herniæ, and the female sex are the commonest conditions.

TUBERCULOSIS OF THE COLON.

Apart from miliary tubercle, the large intestine is liable to two forms of tuberculous disease, both of which specially affect the cæcum and ileocæcal valve.

Varieties.—

ENTERO-PERITONEAL.—Both the serous, mucous, and sub-mucous coats are attacked, with resulting caseation and ulceration. There is no excess of fibrous tissue formation, and therefore no tendency to stricture. The ileum is often involved, and also the appendix. Peritoneal adhesions, local peritonitis, and fæcal fistulæ are common.

HYPERPLASTIC.—The whole wall of the gut is involved in a dense fibrous tissue mass which surrounds the scanty tuberculous foci. Often confined to the ileocæcal valve or cæcum. Produces stenosis and obstruction.

FIBRO-ADIPOSE mass surrounds the affected gut.

LYMPH-GLANDS are enlarged or involved in tuberculous disease. Those in front and behind the cæcum and those lying on ileocolic vessels are chiefly affected.

GUT WALL is transformed into a hard, rigid, fibrous mass.

MUCOUS MEMBRANE is ulcerated, or forms irregular polypoid granulations.

ILEUM AND APPENDIX are never involved in this variety.

MICROSCOPICALLY, the tuberculous giant-cell systems and bacilli are very scanty. Bacilli are seldom found in the fæces.

Tuberculosis of the Colon, *continued*.

Age and Sex.—

THE ENTERO-PERITONEAL FORM is found at any age, with no special tendency to occur at one period of life.

THE HYPERPLASTIC FORM occurs usually between 20 and 40.

Cases in children and old people are rare.

The sexes are affected alike.

Symptoms.—

IN THE ENTERO-PERITONEAL FORM.—

ONSET resembles subacute appendicitis, a tender inflammatory mass forming in the right iliac fossa.

DIARRHŒA, with passage of blood and mucus.

THE INDURATED MASS becomes larger and harder, and after weeks or months a stercoral abscess bursts, and fistulæ result in the inguinal, femoral, lumbar, or umbilical regions.

LUNG COMPLICATIONS are common.

IN THE HYPERPLASTIC FORM.—

ONSET is very insidious.

CHRONIC OBSTRUCTION, with colic, gurgling, constipation, and visible peristalsis.

TUMOUR forms in right inguinal region. It is hard, movable, and has the form of the cæcum.

DEATH occurs within two to three years from intestinal obstruction.

Diagnosis.—

ENTERO-PERITONEAL FORM from:—

APPENDICITIS.—In this the onset is more acute, the course more rapid. Bloody diarrhœa is rare.

ACTINOMYCOSIS.—In this the mass is harder, the parietes are more involved. Sulphur-like granules are discharged.

HYPERPLASTIC FORM from:—

CANCER OF THE CÆCUM OR COLON.—This diagnosis is often not made until the mass has been removed and microscoped.

In cancer the onset of obstruction and the course of the disease are more rapid. The tumour is more irregular.

Treatment.—

IN THE ENTERO-PERITONEAL FORM.—

LOCALLY ABSCESES ARE OPENED, and usually result in fæcal fistulæ. Removal of diseased focus is impossible because of adhesive matting.

SHORT-CIRCUITING the intestine above and below the disease through an opening in the mid-line will usually bring about a cure. Union of the ileum to the upper pelvic colon, with complete division of the former, is the most useful operation.

IN THE HYPERPLASTIC FORM.—

EXCISION of the affected part, together with the neighbouring lymph-glands.

PRELIMINARY ILEOSIGMOIDOSTOMY may be done in cases with much distension.

CARCINOMA.

Age and Sex.—Commonest between 40 and 50. Cases of cancer of the colon in patients under 30 are not so rare as in other situations.

Situation.—Of cancer of all parts of the intestine the following is the comparative incidence: rectum, 52 per cent; colon (including cæcum, ileocæcal valve, and appendix), 43 per cent; small intestine, 5 per cent.

Of cancer of the cæcum and colon the figures are: pelvic colon, 55 per cent; splenic flexure, 15 per cent; cæcum, 9 per cent; transverse colon, 8 per cent; descending colon, 4 per cent; ascending colon, 4 per cent; hepatic flexure, 2 per cent. (Burgess.)

Pathology.

HISTOLOGY.—Always columnar-celled growths.

Marked hypertrophy of the muscular coats occurs both at and above the growth.

The muscular layers become invaded by columns of epithelial cells.

Small-round-cell proliferation is well marked, and becomes transformed later into connective tissue.

Colloid degeneration of both primary and secondary growths is common.

MACROSCOPIC APPEARANCE.—It is convenient to distinguish four different types of growth.

1. **ANNULAR.**—The growth forms a tightly constricting ring of dense hardness. The lumen is almost obliterated (*see Fig. 134, p. 474*). It is of slow development, it produces symptoms of obstruction early, and is the most favourable type for radical treatment.
2. **TUBULAR.**—A considerable length of the gut becomes transformed into dense new growth. Adhesions and fixation are well marked.
3. **ULCERS.**—The growth forms a deep, hard ulcer, with hard, fungating margins. Passage of blood and mucus results rather than intestinal obstruction.
4. **FUNGATING MASS.**—A soft, friable, rapidly-growing mass spreads into and along the lumen of the bowel. It causes early metastasis and free hæmorrhage, with rapid death.

THE COLON ABOVE THE GROWTH presents various degrees of hypertrophy and dilatation in proportion to the chronicity of the growth.

ULCERATION just above the growth and in the cæcum is common, and may lead to perforation.

ACUTE DILATATION WITH RUPTURE OF THE CÆCUM may occur comparatively suddenly if the growth becomes suddenly occluded, or if purgatives have been injudiciously administered.

Carcinoma of the Colon—Pathology, *continued*.

PERITONITIS may occur in the following ways :—

PERFORATION of a stercoral ulcer.

ACUTE RUPTURE of the dilated gut.

LOCAL SUPPURATION, leading to the formation of an abscess, which may be stercoral.

PLASTIC PERITONITIS, either simple or malignant, causing a matting together of the colon with adjacent parts.

FÆCAL FISTULÆ.—

CUTANEOUS FISTULÆ are most common over the cæcum and at the umbilicus.

BIMUCOUS FISTULÆ may form between the colon and the small intestine and bladder.

SECONDARY GROWTHS.—Metastatic growths are not so frequent or so early as with cancer elsewhere.

THE LYMPHATIC GLANDS which lie on the surface of the colon, and those accompanying the vessels of the part, are affected first. This form of metastasis is commonest with the soft fungating types of growth.

THE LIVER is the seat of secondary growths, especially in the late stages of the slow-growing forms of cancer.

THE PERITONEUM and omentum may be diffusely involved.

This occurs very early in cases of colloid cancer. Extreme ascites results from this peritoneal invasion.

THE LUNGS and other viscera are rarely affected.

Symptoms.—

ONSET.—The onset of symptoms is usually slow and insidious, and apart from intestinal obstruction the growth may remain latent for one or two years.

SUDDEN ONSET of acute obstruction may take place in a patient who has made no complaint of earlier symptoms. This is due to sudden blocking of a stenosed portion of the gut.

GENERAL CONDITION remains good so long as the growth is confined to the colon and before obstruction is marked. The most rapid cachexia supervenes upon peritoneal invasion.

PAIN is of two kinds: (1) INTERMITTENT COLIC, due to the contractions of the gut above an obstruction; (2) CONSTANT PAIN, which occurs only when the growth has become fixed to parts outside the gut.

ABDOMINAL CONDITION.—This is characteristic only if and when obstruction exists.

GENERAL TYMPANITIC DISTENSION of varying grades. In obstruction to the cæcum the central abdominal area is chiefly affected; in that of the pelvic colon, the flanks.

VISIBLE PERISTALTIC CONTRACTIONS.—These are occasioned by the forcible contractions of hypertrophied gut above the obstruction. Its presence always indicates a cause of long

standing, and it serves to distinguish a chronic case with acute onset from one which is of recent origin. The hypertrophied colon usually forms long coils obliquely disposed from above downwards, the pelvic and transverse parts being most often seen. The small intestine forms shorter transverse coils. Audible gurgling often accompanies the peristaltic contractions.

TUMOUR is found in only about 40 per cent of the cases. When it occurs in the pelvic colon or the splenic flexure it is specially liable to be hidden. It is movable in its early stages.

APPARENT SIZE is increased by a faecal accumulation above, by a matting together of neighbouring parts, or by an extension to the omentum. This latter point applies specially to cancer of the transverse colon, in which the great omentum often forms a transverse hard roll.

SPECIAL TESTS.—

BIARIUM MUCILAGE PER RECTUM may be seen to be arrested at the site of the growth.

BIARIUM MUCILAGE BY MOUTH is arrested above the growth.

These last two tests may be used alternately in a doubtful case.

THE SIGMOIDOSCOPE will demonstrate growths in the greater part of the pelvic colon.

RECTAL OR VAGINAL EXAMINATION will often discover a tumour of the pelvic colon which is out of reach of external examination.

ACTION OF THE BOWELS.—

CONSTIPATION, though frequent, is not as pronounced as might be expected. It is often quite absent. Constipation occurring for the first time in a patient of middle life, and getting steadily worse, is suggestive of cancer of the large intestine.

DIARRHŒA alternating with constipation is the most characteristic symptom. It is due to catarrh and ulceration at or above the growth.

TENESMUS is a painful, bearing-down sensation which accompanies and follows defæcation. It is present only when the growth affects the pelvic colon or rectum.

THE FÆCES may contain (1) blood, (2) mucus, (3) pus, or rarely (4) pieces of growth. They are in these circumstances peculiarly offensive, and indicate a rapid ulceration or necrosis of the growth.

Complications.—

ACUTE INTESTINAL OBSTRUCTION (*see* Chapter XXXIX), which may be first indication of disease, is brought on by : (1)

Obstruction of the lumen of the bowel by a faecal mass ; (2) Adhesions or kinking ; (3) Paralysis due to abuse of purgatives or morphia.

Carcinoma of the Colon—Complications, *continued*.

ACUTE PERFORATION usually results from the rupture of a stercoral ulcer. The resulting peritonitis is almost invariably fatal, and is often associated with a subnormal temperature.

FISTULÆ.—AN EXTERNAL FISTULA may actually relieve the distension. AN ENTEROCOLIC FISTULA will cause persistent diarrhœa and rapid marasmus. A GASTROCOLIC FISTULA causes lientery, in which undigested food is passed in the fæces, and true fæcal vomiting. A VESICOCOLIC FISTULA causes cystitis, with the passage of gas and fæces per urethram. A VAGINOCOLIC FISTULA may relieve the obstruction by the passage of gas and fæces by the vagina.

METASTASIS.—ASCITES from multiple peritoneal growths is the commonest sign. THE LIVER may become enlarged and nodular, but secondary growths often occur without this sign.

TOXÆMIA is late in development, and is, next to obstruction, the commonest cause of death.

Course of the Disease.—Uncomplicated cases last from two to five years. The hard and constricting growths have the best prognosis, because of their slow growth, scanty metastasis, and also because they are quickly recognized by the resulting chronic obstruction.

AFTER COLOSTOMY patients often live for a year or more.

Treatment.—Only a minority of cases permit of radical surgical treatment. In the remainder, apart from palliative operations, the chief treatment consists in a light diet of food which contains but little indigestible débris. Milk, soups, and light farinaceous food form the staple, and fish, eggs, and a little meat are allowed. Vegetables, brown bread, and fruit are specially harmful.

EXPLORATORY OPERATION should always be advised in cases of doubtful diagnosis. Especially when the following occur :
(1) Constipation of recent origin and progressive degree ;
(2) Passage of blood, mucus, and pus by rectum ; (3) The existence of visible peristalsis.

Site.—The mid-line below the navel gives access to all parts except the splenic flexure. This may have to be explored through a second incision in the upper part of the left semi-lunar line.

COLOSTOMY may be done as a palliative or preliminary operation.

PALLIATIVE.—Must be above the growth. Either in the pelvic colon, the transverse colon, or the cæcum, the first being much the most frequent. An *axial colostomy* is the best in these cases : the bowel is divided, and a large tube tied in the proximal and a small tube in the distal end.

If the bowel cannot be brought outside the abdomen, a *lateral colostomy* must be done.

If there is no urgent obstruction, the operation ought always to be done IN TWO STAGES, the bowel being brought outside the abdomen and fixed at the first stage, and opened or divided at the second.

PRELIMINARY COLOSTOMY.—If there is a chance of radical removal of the growth, this ought always to be preceded by a colostomy or short-circuiting operation. It is of great advantage to do this at some distance from the growth, because it allows the radical operation to be done in a clean area, e.g., a transverse colostomy should precede excision of a pelvic growth, or a cæcostomy one of the transverse colon.

ANASTOMOSIS OPERATIONS.—These have the same indications as colostomy, but they are possible only in the absence of marked obstruction. A short-circuiting operation has these great advantages over a colostomy: (1) When performed as a palliative operation it avoids the unpleasantness of an artificial anus; (2) When done as a preliminary to excision, the latter operation is simplified to a mere removal without anastomosis. The best short-circuiting operation is an ileo-sigmoidostomy. The ileum should be divided after a lateral junction with the pelvic colon, unless the growth is inoperable and likely to cause complete occlusion, when the lumen of the ileum should be preserved.

RESECTION OF THE GROWTH.—

CONTRA-INDICATIONS.—Metastasis in the liver or peritoneum. Extensive adhesions, or great lymphatic involvement.

EXTENT OF RESECTION.—A long piece of gut should be removed, including several inches above and below the growth, together with a fan-shaped area of peritoneum having its apex at the root of the mesentery. This will include all the lymphatic vessels and glands connected with the growth.

ADVANTAGES OF SECONDARY RESECTION.—In all cases the removal of the growth should be preceded by a colostomy or short-circuiting operation (e.g., ileosigmoidostomy). The advantages of this are:—

1. The intestinal obstruction and toxæmia are relieved before the excision.
2. The chances of sepsis are diminished.
3. Shock is greatly reduced.
4. The malignant mass often becomes smaller and less adherent owing to the relief of congestion.
5. A microscopical examination of the mass can be made before excision.
6. The mortality of the operation is reduced from about 50 per cent to 10 per cent.

CHAPTER XLII.

DISEASES OF THE RECTUM AND ANUS.**CONGENITAL MALFORMATIONS OF
THE RECTUM.**

1. ABSENCE OF RECTUM AND ANUS.—Colon ends at the pelvic brim. The pelvis is narrow and ill-developed. No bulging occurs in perineum when child cries.
2. RECTUM IS PRESENT, BUT THE ANUS IS ABSENT.—Bulging occurs in the perineum on crying.
3. ANUS AND ANAL CANAL ARE PRESENT, BUT DO NOT JOIN THE RECTUM.—Finger feels a partition about one inch above anus.
4. A STRICTURE MAY EXIST where anal canal joins rectum.
TREATMENT OF FOREGOING CONDITIONS.—
 - a. Dilate a stricture by daily passage of bougies.
 - b. Perforate a septal division, and then dilate.
 - c. Where anus is imperforate: Cut upwards in mid-line for two inches; bring rectum down, open, and sew to skin.
 - d. If the rectum cannot be reached from the perineum: Perform inguinal colotomy.
5. RECTUM OPENS INTO OR COMMUNICATES WITH BLADDER, VAGINA, URETHRA, OR VULVA.—
TREATMENT by a plastic operation in slight cases, after preliminary colostomy to divert the fæces.

**PROCTITIS, OR INFLAMMATION OF THE
RECTUM.**

Causes.—Foreign bodies—Fish-bones or other hard material in fæces—Polypus or tumour of the rectum—Piles, fissure, or fistula—Prolapse—Dysentery—Syphilis—Tuberculous ulceration—Gonorrhœa—Parasites: threadworms (in children), bilharzia (in patients from Africa).

Symptoms.—Bearing-down pain. Painful tenesmus. Feeling of weight and fullness in perineum. Discharge of muco-pus from the anus.

Treatment.—

1. Ascertain and remove the cause, e.g., piles, fissure, or foreign body.

2. Copious hot-water enemata. Lead and opium lotion or suppositories in acute stage. Lotio protargol, gr. j ad $\overline{3}$ j, in later stages.
3. For threadworms: Purge, and inject with infusum quassiae.
4. For bilharzia: Scrape away the adenomatous polypi which contain the eggs.
5. Incision of sphincter or colostomy if other means fail.

ISCHIORECTAL ABSCESS.

Anatomy.—Ischiorectal fossa is triangular in vertical section. Outer wall is formed by ischium clothed by obturator internus. Inner wall is formed by the rectum clothed by levator ani. Lower wall is formed by the skin. In front is the triangular ligament. Behind is the border of the gluteus maximus.

Sources of Infection may be: Through any of the three walls or from in front.

1. Through rectum by ulceration or perforation of foreign body.
2. Through skin by wound abrasion or sebaceous gland.
3. Through the outer wall from disease of pelvis.
4. From the urethra in front.

Varieties.—

1. CELLULITIS.—Possibly gangrenous. Diffuse cellular infection from the bowel or skin. Generally in feeble old people.
2. ACUTE ISCHIORECTAL ABSCESS.—*Bacillus coli* infection from the bowel, or a pyogenic infection from the perineum.
3. CHRONIC ABSCESS.—Generally tuberculous in origin.

Symptoms.—Those of local inflammation. Brawny swelling in the perineum. Hot, very painful, swelling felt per rectum. Defaecation is very painful. Bursts either through the skin or into the bowel, or in both directions at once. Often results in a fistula.

Treatment.—

ACUTE CASES.—Open freely from the perineum, and drain. If an opening exists into the bowel, treat like a fistula.

CHRONIC CASES.—Try scraping and stuffing with iodoform. Liability to sepsis makes healing bad. Colostomy has often to be performed.

FISTULA IN ANO.

Definition.—Any sinus associated with the anus.

Varieties (Figs. 140, 141, 142).—

1. COMPLETE.—Sinus opens into the rectum internally, on to the perineum externally.
2. INCOMPLETE EXTERNAL.—A perineal sinus not opening into the rectum.
3. INCOMPLETE INTERNAL.—A sinus opening into the rectum, but not externally.

Fistula in Ano, *continued.*

Causes.—The causes of proctitis. Ischiorectal abscess. Ulceration or stricture low down in the rectum : malignant, tuberculous, or syphilitic.

Anatomy.—A suppurating or granulating sinus communicates with one or both openings. It runs outside the bowel entirely, or more frequently perforates the gut obliquely, so running some distance between mucous membrane and muscular coat. May almost encircle the bowel. The internal opening is usually single, however many external openings there are. The external openings are usually multiple. The track runs either through the fibres of the external sphincter or, more commonly, superficial to it. The fistula, like the abscess from which it originates, is chiefly : (a) Ischiorectal; (b) Pelvic; or (c) Submucous.

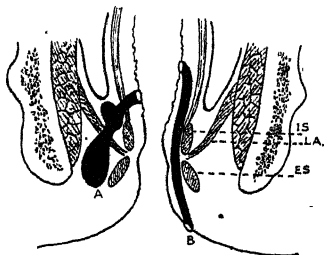


Fig. 140.—Diagram of fistulæ in ano. I.S., Internal sphincter; E.S., External sphincter; L.A., Levator ani; A, Blind internal fistula, partly pelvic and partly ischiorectal; B, Complete submucous fistula.

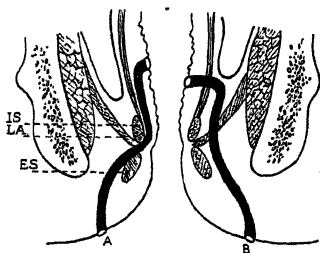


Fig. 141.—Diagram of fistulæ in ano. I.S., Internal sphincter; E.S., External sphincter; L.A., Levator ani; A, Complete submucous and ischiorectal fistula; B, Complete pelvic and ischiorectal fistula.

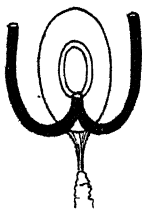


Fig. 142.—Diagram of horseshoe fistula of the anus. There is a single central internal opening and a double lateral external opening; the fistula runs nearly all round the anal canal. (After Miles.)

IN CHRONIC CASES: Dense cicatricial tissue forms round the sinus. Multiple diverticula branch off in various directions, especially upwards between the sacrum and anus. Both internal and external openings become multiple.

Symptoms.—Pain, especially at defæcation. Purulent discharge from a sinus, or from anus with or after the motion.

Treatment.—

PRELIMINARY.—Saline aperients for several days. Opium pill, gr. j, 12 hours before operation. Enema just before operation.

OPERATION.—Pass a director up the fistula. Open it completely from end to end. Scrape out all granulations and cut out scar tissue. Open up all secondary channels and sinuses. Pack deeply with oiled gauze.

IN DEEP FISTULÆ WHICH ARE PELVIC IN ORIGIN.—If the fistula opens above the internal sphincter, it is dangerous to divide that muscle and the levator ani, because fæcal incontinence will result. The fistula must be opened freely from the perineum by a T-shaped incision and allowed to granulate from the bottom.

IN CHRONIC OR COMPLICATED CASES.—Either excise the lower end of the rectum, retaining the sphincter (Kraske's operation), or perform an inguinal colostomy.

FISSURE IN ANO.

Definition.—A longitudinal ulcer in the anal margin.

Situation, etc.—Usually single and in mid-posterior line, where the anus is most firmly fixed to the coccyx.

Below the fissure is a 'SENTINEL PILE', which is a tag of mucous membrane that has been torn down by a scybalous mass, so forming the ulcer.

Rather commoner in men than women.

Symptoms.—Severe burning pain during and after defæcation, with great tenesmus. Fæces may be streaked with blood.

Treatment.—Laxatives and copious hot enemata. Cocaine suppositories and the unguentum gallæ c. opio.

OPERATIVE.—Under an anæsthetic: (1) Dilate the sphincter; (2) Remove all piles, especially 'the sentinel'; (3) Cut out the ulcer, making the incisions extend right through the sphincter so as to paralyse it temporarily.

FIBROUS STRICTURE OF THE RECTUM.

Etiology.—Elderly patients. Usually women. Follows: (1) Ulceration due to dysentery, tubercle, or syphilis; (2) Cellulitis contracting outside the gut; (3) Other conditions of proctitis, e.g., that due to gonorrhœa or piles.

Fibrous Stricture of the Rectum, *continued*.

Anatomy.—Stricture is situated two or three inches from the anus. It may be: (1) Annular and smooth; (2) Long and irregular; (3) Tied to the sacrum. The gut above is hypertrophied, dilated, and ulcerated. The gut below is often ballooned.

Symptoms.—Alternating attacks of constipation and diarrhoea. Attenuated moulded fæces, with scanty blood and mucus. Chronic intestinal obstruction. Ischiorectal or pelvic abscesses may form by rupture or infection through a stercoral ulcer. Large faecal abscesses may form in the buttock, and cause death or chronic fistulæ.

Treatment.—

DILATATION by graduated bougies, when these can be borne.

EXCISION of the stricture when it is short and the bowel above and below healthy and free.

SACRAL OR INGUINAL ANUS in the worst cases.

SYPHILIS OF THE RECTUM AND ANUS.

Primary Chancre is rarely situated at the anus.

Secondary Condylomata are very common round the anus.

Tertiary Gummata form a diffuse infiltration of the rectal wall. They are commoner in women than men. The disease begins in the submucous tissue. Ulceration soon follows, and is deep but comparatively painless. It may extend to the anus, sigmoid, vagina, perineum, or bladder, and form fistulæ. It usually results in an extensive stricture.

SYMPTOMS.—Some pain and rectal tenesmus. Discharge of blood and pus per anum. Later, the signs of chronic obstruction.

TREATMENT.—

1. SALVARSAN, MERCURY, AND IODIDES until all active disease has been arrested.
2. Temporary or permanent COLOSTOMY.
3. In a very few cases when the stricture is short, EXCISION.
4. Resulting stricture to be treated by BOUGIES.

NEW GROWTHS OF THE RECTUM AND ANUS.

Polypos, or stalked adenoma, consists of simple gland tissue with more or less connective tissue connected to the submucous coat by a vascular pedicle. It is commonest in children. It may cause some rectal pain, irritability, or prolapse.

TREATMENT by ligature and removal.

Papilloma.—May be localized or a diffuse growth, with a tendency to free hæmorrhage. It is of rare occurrence.

TREATMENT by removal.

Bilharzia Papilloma is a polypoid outgrowth of mucous membrane, bleeding freely, in which many bilharzia ova are found.

Epithelioma attacks the anus. Often in the site of an old fissure. It may form a warty mass, but soon becomes ulcerated. It is indurated, its edges are hard and everted. It bleeds very freely, and has a copious foul discharge. Secondary deposits occur very early in the inguinal glands.

TREATMENT by early free removal, together with the glands in both groins.

Sarcoma is a rare disease, occurring in young patients (under thirty). It forms a rather diffuse growth in the submucous tissue which causes obstruction. Ulceration is absent or late.

TREATMENT.—It should be removed, but recurrence is likely.

Carcinoma.—*See below.*

CARCINOMA OF THE RECTUM.

Etiology.—A little commoner in men than women, and occurs generally after middle life.

Anatomy.—It begins in the mucous membrane, and thence spreads : (1) Into the lumen of the gut ; (2) Up and down the gut ; (3) Out through the gut wall in neighbouring structures.

ITS MACROSCOPIC STRUCTURE may be of three types :—

1. A FUNGATING FRIABLE MASS projecting into the bowel.
2. AN ULCER with hard raised margin, of considerable extent (*see Fig. 22, p. 73*).
3. A FIBROUS ANNULAR CONSTRICTION with comparatively little new growth or ulceration.

The bowel above and below shows the same changes as are described in the section on intestinal obstruction (p. 456).

MICROSCOPICALLY it is always a columnar-celled carcinoma, which often shows colloid degeneration, and in which the proportion of glandular and fibrous tissue varies. Thus, in the soft, rapidly growing kinds, the glandular tissue predominates, whilst the hard annular varieties consist chiefly of fibrous tissue.

Extension occurs outwards through the bowel wall, and may involve : (1) The cellular tissue ; (2) The sacrum ; (3) The pelvic vessels and nerves ; (4) The vagina or uterus ; (5) The prostate, bladder, and ureters. In the case of the vagina or bladder a bimucous fistula may result by ulceration.

Metastasis is comparatively late and rare. It occurs : (1) In the lumbar glands ; (2) In the liver and peritoneum ; (3) In the inguinal glands when the anus has been involved.

Symptoms and Signs.—

1. EARLY, BEFORE OBSTRUCTION.—

PAIN of a dull, dragging kind, with some tenesmus. This may be quite absent.

Carcinoma of the Rectum—Symptoms and Signs, *continued*.

BLEEDING both with and between the motions.

Passage of offensive blood-stained mucus.

Rarely the motions may become narrow and moulded.

DIARRHŒA alternates with constipation.

ON EXAMINATION, a mass is found which is either (a) Friable and fungating, or (b) Hard, with ulcerated surface and everted margins. The mass is not fixed in any way, and on straining the bowel descends as a whole.

2. **ADVANCED, WITH OBSTRUCTION.**—The signs and symptoms of chronic intestinal obstruction are added to the above. Great abdominal distension, with visible peristalsis. Pronounced constipation, with colicky pain, which is increased by purgatives. Pain and tenesmus are much more constant and severe.

ON EXAMINATION, the lumen of the bowel is partially obliterated by a stricture or fungating mass.

3. **INVOLVEMENT OF NEIGHBOURING STRUCTURES.**—Severe constant or neuralgic pain is caused by extension to the sacrum and sacral nerves. Œdema, by involvement of the vessels. Gas or fæces may be voided from the urethra, and cystitis supervene from bladder extension. Hydronephrosis, pyonephrosis, and uræmia, from blocking of the ureters. Gas and fæces may be passed from the vagina.

An abscess may form in the pelvis, ischiorectal fossa, or buttocks, and give rise to one or many fistulæ, which communicate with the gut above the growth.

ON EXAMINATION, the growth is fixed and the bowel does not come down at all on straining. This fixity may be only partial, e.g., to the bone behind or vagina in front, or it may be complete, the whole bowel circumference being involved.

4. **LATE CACHEXIA** with secondary growths.—This stage is often never reached, the patient dying either from intestinal obstruction or sepsis. Masses of glands may be felt in lumbar regions. Liver becomes large and nodular; ascites develops.

Course.—Varies very much. In young patients and with soft fungating growths the whole course may be only one year. In older patients and with fibrous growths it may last five years.

Diagnosis.—This is usually easy if the case is examined locally. In the early stages it is impossible to diagnose cancer from piles, prolapse, polypus, or fistula without a RECTAL EXAMINATION.

IN PILES there is no new growth, but merely swollen veins, but it is important to remember that piles often complicate cases of cancer, so that the inside of the bowel should be examined in every case of piles.

IN FISSURE the pain is much more severe, and is almost unbearable on digital examination. A linear ulcer with sentinel pile is evident, and the inside of the bowel is healthy.

IN POLYPUS the mass is small and pedunculated, and the mucous membrane healthy.

IN FIBROUS STRICTURE the parts are indolent and there is no new growth. Bleeding on examination is absent or very slight.

IN SYPHILITIC DISEASE the gummata are soft, painless, and non-vascular. The ulcers are ragged, undermined, and not at all indurated.

IN PROLAPSE AND INTUSSUSCEPTION inspection and palpation will make the case clear.

NOTE.—THE SIGMOIDOSCOPE is useful for cases of cancer occurring out of reach of the finger (three to twelve inches from the anus).

Treatment.—

CASES UNSUITED FOR EXCISION are nearly 70 per cent of all seen. Growth is fixed to the bladder, prostate, or ureters, or to the sacrum high up. Extension into the cellular tissue or glands. Metastatic growths. Condition of age and debility.

TREATMENT.—Soft food with little debris, avoiding fruit, vegetables, etc. Bowel washed out through a soft tube daily. Olive oil enemata.

COLOSTOMY for obstruction.

LOW OPERATION: PERINEAL EXCISION.—

INDICATIONS.—For cases in which the disease extends within one inch of the anus, but not higher than the finger can reach.

METHOD.—After a preliminary colostomy, the anus is excised with the lower end of the bowel well above the growth. The wound is either plugged round a central tube without any stitching of the gut to the skin, or a few anchoring stitches may be used.

HIGH OR TRANS-SACRAL EXCISION.—Now almost obsolete.

INDICATIONS.—For cases in which the sphincter ani can be preserved. The disease ought not to extend higher than five inches from the anus, i.e., above the third piece of the sacrum.

METHOD.—A preliminary colostomy ought always to be done: (1) To ascertain presence of other growths and the extent of the rectal disease; (2) To divert the fæces from the wound; (3) To relieve obstruction.

After excising the coccyx, the incision is produced up over the sacrum, and the lower part of this removed obliquely or transversely, keeping below the third piece; otherwise the sacral plexus will be injured.

The bowel is isolated, usually the peritoneal cavity is opened and packed. As much of the posterior cellular tissue and glands as possible are removed from the pelvis.

Carcinoma of the Rectum—Treatment, *continued*.

The growth is excised, and the ends of the bowel above and below are sutured.

ABDOMINO-PERINEAL METHOD.—This is the operation of choice, but owing to its severity is contra-indicated in the feeble.

INDICATIONS.—May be used for all cases ; it is specially suitable for cases in which the disease extends above the 3rd sacral vertebra.

It has the advantage of allowing a thorough exploration of the abdomen for metastatic growths, of allowing a free removal of lymph-glands and cellular tissue from the pelvis, and of making a much freer removal of bowel possible (*Fig. 143*).

METHOD.—Two stages :—

First Stage.—Through a median incision the abdomen is explored, the bowel is freed from the bladder in front and the sacrum behind. The superior and middle hæmorrhoidal vessels are secured. The pelvic mesocolon is liberated enough to allow the sigmoid flexure to drop into the pelvis. The colon is divided and the upper end brought out as an artificial anus.

Second Stage (10 days later).—Rectum, anus, and levatores ani are removed from the perineum.

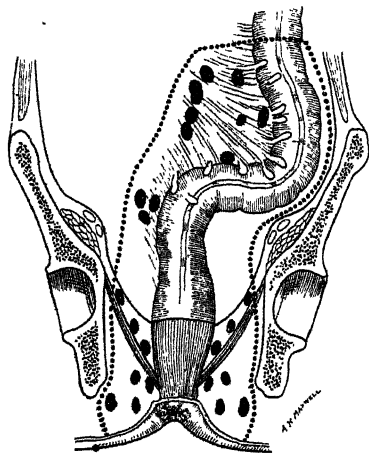


Fig. 143.—Diagram of the parts removed by abdomino-perineal excision of the rectum, indicated by the dotted line. The black spots are the lymph glands involved by cancer of the rectum. (*After Miles.*)

Results of Excision of Cancer of the Rectum.—

IMMEDIATE MORTALITY is about 15 per cent.

SURVIVAL.—Of those recovering from operation, 25 per cent survive for three years or longer. The prognosis for survival is very bad in cases where the anus is involved. Such cases seldom if ever survive three years.

RECURRENCE.—In about two-thirds of the cases when recurrence takes place it occurs within two years of the operation. The site of recurrence in 74 per cent is local in or round the rectum; in 24 per cent is in the form of visceral metastasis; and in 4 per cent in the lymphatic glands. The average length of life of those in whom recurrence occurs is about two years.

HÆMORRHOIDS OR PILES.

Definition.—Varicose veins of the anal region.

Causes.—Pressure of the blood in the portal system. Absence of valves in the portal veins. Anastomosis between the portal and systemic system that occurs between the superior, middle, and inferior hæmorrhoidal veins. Any portal congestion, cirrhosis of the liver, or intra-abdominal tumour. Alcoholism and chronic constipation.

Specially common in young men and middle-aged pregnant women.

Varieties.—External and internal.

External Piles are covered by skin.

CONSIST of a central vein covered by a tag of hypertrophied skin.

SYMPTOMS are slight. Pruritus and some pain. Inflammation and thrombosis or suppuration are frequent.

TREATMENT by hamamelis ointment and careful washing. Fomentations when inflamed. Excision must be sparingly done, so as to avoid excessive cicatrization.

Internal Piles occur inside the sphincter, and may extend two inches up the bowel.

CONSIST of varicose veins covered by hypertrophied mucous membrane. They form a series of fleshy, purple masses inside the anus, some being thick, firm, and fleshy, and others thin-walled and easily bleeding.

SYMPTOMS.—Pain and dull aching after defæcation. Very sharp pain is due to a fissure.

BLEEDING after defæcation, the blood being spattered over the pan.

Mucoid discharge, with tendency to prolapse.

COMPLICATIONS.—

INFLAMMATION and thrombosis. If suppurative, may cause portal pyæmia.

STRANGULATION and sloughing by pressure of the sphincter on prolapsed piles.

PROLAPSUS RECTI.

FISSURE IN ANO.

Internal Piles, *continued*.

TREATMENT.—

GENERAL.—Saline aperients, and plenty of exercise.

LOCAL.—Washing after defæcation. Astringent ointments, e.g., the unguentum hamamelis or unguentum gallæ c. opio.

BY INJECTION.—Each pile is injected at its base with 5 min of a 20 per cent solution of carbolic acid in glycerin. Several treatments may be required. An anæsthetic is not necessary, nor does the patient need to lie up afterwards.

OPERATIVE.—Where bleeding or pain is severe, and where no serious permanent portal congestion, e.g., cirrhosis, exists.

Preliminary.—Purgative, e.g., castor oil following salines.

Discontinue these forty-eight hours before. Enema twelve hours before operation.

Lithotomy position. Four methods: (1) *Clamp and cautery*; (2) *Ligature and excision*; (3) *Crushing*; (4) *Whitehead's operation*, or an excision of the whole pile-bearing area of mucous membrane. This is liable to be followed by intractable ulceration or by some stenosis of the anus.

Bowels are kept confined for six days after.

PROLAPSE OF THE RECTUM.

INCOMPLETE.—Is commonly associated with piles in adults, when only the mucous membrane protrudes.

COMPLETE.—Is common in children, when all the coats extrude.

Cause.—(1) Relaxed conditions of the tissues; (2) Constant straining, e.g., large prostate; (3) Diarrhoea or worms; (4) Chronic constipation, piles.

Signs, etc.—Protruding mass at the anus, with central orifice communicating with the lumen of the rectum, its walls joining the skin at the anal margin. Mucoid discharge and bleeding. Incontinence of fæces when it is chronic. Strangulation and sloughing are very rare.

DIAGNOSIS from piles, polypus, and intussusception.

Treatment.—

PALLIATIVE.—Removal of any cause of straining or any rectal irritation, e.g., worms or piles.

ASTRINGENT LOTIONS.—Defæcation in a lateral position the last thing at night; a pad soaked in the lotion is tied on with a T bandage over the anus.

OPERATIVE.—

Removal of the mucous membrane in incomplete prolapse.

Linear scarification, injection of astringents or of paraffin.

Excision of the whole projecting tumour, with suture of the bowel, in complete cases.

Colopexy, or suture of the sigmoid flexure to the parietes, in a very few relapsing cases.

Incision into the space between the anus and coccyx. This is then packed with antiseptic gauze and the space allowed to heal by granulation from the bottom. The contraction of this holds the bowel in position.

PRURITUS ANI.

Definition.—A condition characterized by intense itching around the anus.

Causes.—

1. IN ADULTS.—The common cause is a constantly damp condition of the anal skin due to leakage. This may be due to :
(a) Internal piles or polypus, by prolapsing into the sphincter ;
(b) Fissure ; (c) Fistula ; (d) Catarrhal proctitis.
2. IN CHILDREN.—Almost always due to worms.

Pathology.—The skin around the anus is moist and corrugated, and usually shows abrasions from scratching. Pruritus is only a symptom arising from some primary cause, but it may continue after the original cause has cleared up. Probably after existing some time changes take place in the skin and nerves resulting in a true sensory neurosis.

Clinical Features.—Intense itching is complained of, beginning just at the margin of the anus. The most intense irritation is generally just at the opening of the anus and along the median raphe in front and behind. Sometimes it is more or less continuous, while at other times it comes on in bouts. It is generally worse at night. Many patients are quite unable to sleep for weeks and have their lives rendered utterly miserable. They often state that the intense irritation is more difficult to bear than pain. It is much commoner in men than in women.

Treatment.—

A careful examination of the rectum and anus must be made, and any local condition removed.

Careful washing of the surrounding parts, and afterwards applying 1-40 carbolic lotion or a dusting powder, often relieves.

Ball's operation, in which, by dissecting up a flap of skin around the anus, the nerves are divided, gives good results.

CHAPTER XLIII.

AFFECTIONS OF THE LIVER AND BILE-DUCTS.**WOUNDS OF THE LIVER.****Non-penetrating Wounds (Subcutaneous Rupture).—**

CAUSES.—Buffer accidents—Running over—Blows, kicks, falls, etc.—Fracture of ribs.

PREDISPOSING.—Fatty or congested liver.

VARIETIES.—

CONTUSION.—Ecchymosis. Glisson's capsule is unruptured.

RUPTURE.—Glisson's capsule ruptures. A portion of liver may be detached completely.

SITUATION, ETC.—Right lobe most common. Antero-posterior laceration. May be transverse in superior surface if caused by doubling up of liver.

SYMPTOMS.—

SHOCK, from violence of accident.

COLLAPSE, from internal hæmorrhage.

BRUISE, from point of application of force over the liver.

PAIN over liver down to navel and up to scapula or ensiform cartilage.

PERITONEAL HÆMORRHAGE.—Abdomen is held rigid. Shifting dullness appears in the flanks; most marked on the right side. Pulse becomes increasingly rapid. The distension and dullness increase rapidly.

URINE may contain bile or sugar.

PULMONARY EMBOLISM occasionally results from liver tissues forming an embolus.

FRICTION SOUNDS over the liver may be heard later.

TREATMENT.—Usual treatment for shock. Open abdomen if hæmorrhage is evident or collapse continues. Incise through linea alba. Stitch up liver, or pack with gauze. Purse-string sutures may be used for small wounds. Incision may be enlarged by cutting round costal margin.

Penetrating (External) Wounds.—Stabs—Gunshot—Lacerated etc. (impaled). Much rarer than rupture.

SYMPTOMS.—Shock and collapse.—External or internal hæmorrhage (rapidly fatal)—Escape of bile—Vomiting—Hiccough.

LATER SYMPTOMS.—Tympanitic distension of abdomen—Rigors—Delirium—Peritonitis—Secondary hæmorrhage—Abscess.

DIAGNOSIS from position, direction, and depth of wound.

TREATMENT.—If hæmorrhage and shock increase, open abdomen and plug or suture. In gunshot wounds, remove missile if possible.

WOUNDS OF GALL-BLADDER OR DUCTS.

Penetrating Wounds.—

CAUSES and SYMPTOMS as in wounds of liver, but escape of bile is more marked. Bile soon makes its appearance in the urine.

RAPID DEVELOPMENT OF PERITONITIS.

TREATMENT.—

Complete exposure by laparotomy.

WOUND OF GALL-BLADDER.—Sew up if small, and close abdomen.

Sew to abdominal incision if large, or remove gall-bladder.

WOUND OF CYSTIC DUCT.—Cholecystectomy.

WOUND OF HEPATIC DUCT.—Tie ends of duct.

WOUND OF COMMON BILE-DUCT.—Tie open ends. Cholecyst-enterostomy.

Rupture of Gall-bladder or Ducts.—

CAUSES.—Traumatism: kick, blow, run-over, etc., especially when gall-bladder is distended and a calculus is present—Ulceration from calculus—Typhoid fever—Tubercle—Ascaris—Malignant disease (very rare)—Dilatation from blocking duct.

PATHOLOGY.—

IF SUDDEN AND EXTENSIVE: General peritonitis results rapidly.

IF GRADUAL: An encysted fluid collection amounting to several gallons may result.

Continuity of bile-duct may be restored in few weeks in latter case, and this has been proved experimentally.

SYMPTOMS.—Either immediate septic peritonitis, or localized peritonitis, followed by fluctuating tumour—Jaundice—Bile in urine—Clay fæces.

DIAGNOSIS is that of acute peritonitis associated with traumatism, jaundice, or history of gall-stone colic.

TREATMENT.—

IN SUBACUTE or OBSCURE CASES.—Keep in bed. If localized swelling occur, laparotomy.

IN ACUTE CASES.—Immediate laparotomy. Details as in case of penetrating wounds (*see above*). A septic gall-bladder should always be drained, or removed.

CHOLECYSTITIS.

Definition.—Inflammation of the gall-bladder. This is usually associated with the presence of gall-stones, and the latter by their mechanical effects dominate the clinical picture, but cholecystitis may be a primary condition.

Etiology.—Caused by infection by *B. typhosus*, *B. coli*, streptococci, or staphylococci.

Cholecystitis, *continued*.

Varieties.—

EARLIEST FORM.—This is merely a catarrhal inflammation, associated with a villous thickening of the mucous membrane in which cholesterin is deposited. This type is known as the *strawberry gall-bladder* or *cholesterosis*.

SYMPTOMS.—Vague discomfort or right hypochondriac pain with vomiting and constipation.

LATER OR MORE ACUTE VARIETIES.—Produce distension of the gall-bladder with muco-pus, massive thickening, and dilatation or sloughing. A local peritonitis or abscess may occur from perforation, but general peritonitis is very rare.

SYMPTOMS.—Localized pain, with tumour formation. Vomiting, constipation, and fever.

Treatment.—Removal of the gall-bladder. In the gangrenous type, or when a local abscess has formed, the gall-bladder must be drained as a first stage, and removed later if a chronic fistula results.

GALL-STONES.

Causes.—

1. **STAGNATION OF BILE.**—From sedentary habits, corsets which impede the flow of bile by impeding respiratory movements, and constipation. The bile salts are said to undergo decomposition so that the bile becomes acid and cholesterin is precipitated. There is very little real evidence to support this view. In obstruction of the common duct from carcinoma, although the bile becomes extremely viscid, stones, cholesterin or otherwise, are never formed.

2. **INFECTION OF THE GALL-BLADDER.**—Naunyn showed that the cholesterin comes from the epithelium of the gall-bladder and not from the bile. The formation of gall-stones depends on the presence of an inflammatory catarrh of the gall-bladder mucous membrane in which the amount of cholesterin is greatly increased, the desquamated epithelial cells and bacteria acting as a nucleus.

CAUSE OF THE INFECTION.—The common organisms are *B. coli* and *B. typhosus*. These have been found in the gall-stones. There is often a history of previous typhoid fever. The path of the infection is probably the bloodstream. It is probable that stones are only formed if the infection is chronic and attenuated; if acute, the excess of cholesterin does not occur. The frequency of gall-stones in women is probably due to the great frequency with which *B. coli* infections occur in women who have been pregnant.

3. **FOREIGN BODIES** (rare).—Needle, ascaris, distoma, hydatid, etc.

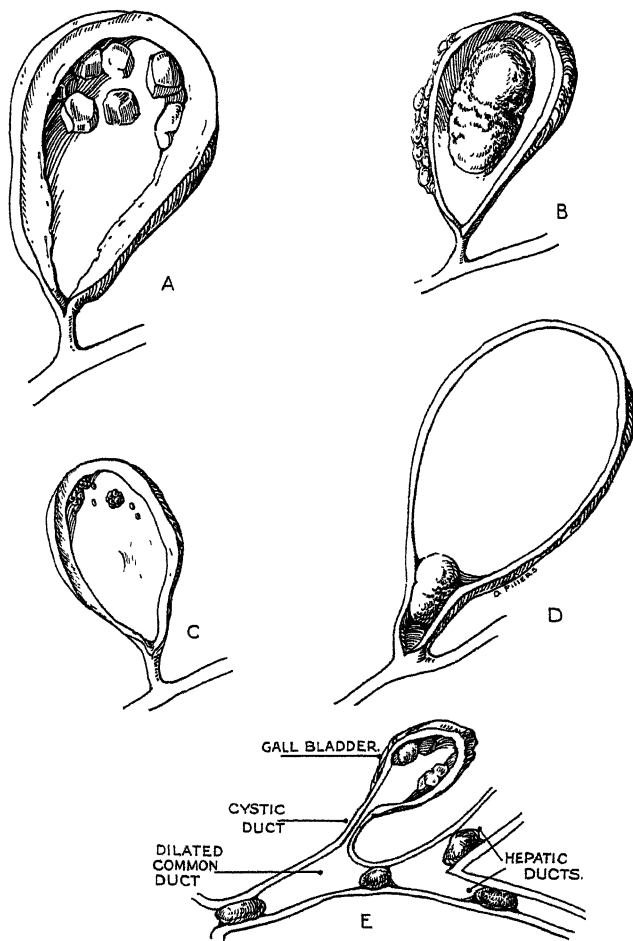


Fig. 144.—Diagram of various conditions of gall-stones and gall-bladder. A, Cholecystitis, with multiple faceted stones and thick gall-bladder; B, Single cholesterol stone; C, Gall-bladder with small mulberry stones; D, Single stone impacted in cystic duct, gall-bladder dilated; E, Stones in ampulla of Vater, common duct, hepatic ducts, and gall-bladder. The shape of the gall-bladder is diagrammatically simplified, Hartmann's pouch not being shown.

Gall-stones, *continued*.

Seat of Formation.—Generally in gall-bladder. May be found in cystic or common duct—more rarely hepatic duct. (*Fig. 144.*)

Structure.—Three layers: Nucleus—Middle layer—Outer layer.

NUCLEUS.—Consists of: Clump of bacteria—Mucus—Blood-clot—

Casts of bile capillaries, or foreign body, or crystals of CaCO_3 .

MIDDLE LAYER.—Laminated layers of cholesterin crystals.

EXTERNAL LAYER.—Bilirubin combined with a calcium salt.

Varieties.—Compounds of cholesterin and bilirubin-calcium. Either substance nearly pure. Latter in calculi formed in liver.

Occurrence.—In 4 per cent of all males; in 20 per cent of all females; in about same proportion, i.e., 1 in 5, they give rise to symptoms.

Age-occurrence.—Unknown in children. Common in mid-life—30–50. Commonest in old age—but often latent.

Great frequency and latency in old age are probably due to degeneration of muscular tissue of gall-bladder and ducts.

Symptoms from the presence of gall-stones vary according to their site, the presence of infection, and according to whether they are stationary, or, having moved, become impacted.

GALL-STONE COLIC only occurs with a stone in a duct, and then with the movement or impaction of the stone. The colic consists in a sudden agonizing attack of pain beginning in the hypochondriac or epigastric region and radiating towards the umbilicus and right scapula. It lasts from a few minutes to several hours; it is accompanied by collapse, feeble pulse, clammy skin, and, towards the end of the attack, vomiting. There may be repeated attacks within a few hours.

JAUNDICE occurs by blocking of the hepatic or common ducts. The presence of a stone in these ducts does not necessarily cause obstruction; it is when infection, causing swelling of the mucous membrane, or impaction of the stone, occurs that complete obstruction followed by jaundice results. The jaundice occurs 12 to 36 hours after an attack of colic, and usually disappears 2 or 3 days after. The retention of bile pigments is shown first by appearing in the urine, causing it to be of dark brown colour; later the sclerotics of the eyes become yellow, and then the skin. The faeces become clay-coloured. It is said that jaundice occurs in only 15 per cent of cases in which there are stones in the cystic duct, and only in 40 per cent of cases of stones in the common duct.

TEMPERATURE.—Sometimes rigors, with temperature of 103° or more, occur after colic. Probably due to septic infection at seat of ulceration. Fever may be of an intermittent type (Charcot's intermittent fever), associated with catarrh of the bile-ducts and an impacted calculus. May be remittent and lead on to septicæmia or septic endocarditis: associated with suppuration in bile-ducts.

CALCULI IN GALL-BLADDER.—

- a. UNCOMPLICATED.—History of many years of gall-stone dyspepsia. Dull aching pain in epigastrium coming on immediately or shortly after food. Sense of fullness and distension, accompanied by flatulence and belching of wind; this is especially brought on by foods such as pastry, cheese, etc. There are often no physical signs. The patient is often stout and past middle age.
- b. COMPLICATED BY ACUTE CHOLECYSTITIS.—After many years of above symptoms, attacks of more acute pain occur. These commence in right hypochondrium and epigastrium, and radiate to the back and shoulders. Onset frequently with mild shivering attack, often associated with pyrexia. Vomiting is common. The pain after meals is often increased, and may occur at night and be relieved by food, thus simulating duodenal ulcer.

Physical Signs.—There is tenderness over the gall-bladder. This is best elicited by Murphy's sign, in which with the patient in a sitting position the surgeon hooks his fingers upwards under the costal margin on each side. On the patient taking a deep breath the tender gall-bladder causes a sudden reflex inhibition of respiration. Boas' sign is the presence of an area of superficial tenderness from the transverse processes of the vertebræ to the posterior axillary line between the 11th dorsal and 1st lumbar spine levels.

- c. COMPLICATED BY SUPPURATIVE OR GANGRENOUS CHOLECYSTITIS.—The symptoms may commence as an acute cholecystitis and instead of clearing up in two or three days may progress, or the onset may be abrupt with severe pain in epigastrium with vomiting, rigors, pyrexia, and marked tenderness of the upper right rectus muscle. The condition resembles an acute appendicitis, only in the upper right quadrant of the abdomen instead of the lower. On examination, if the local tenderness permits, a mass may be felt in the right hypochondrium consisting of a distended gall-bladder wrapped in great omentum. If surgical treatment is not adopted, perforation of the gall-bladder with general peritonitis may ensue.

CALCULUS IN CYSTIC DUCT.—

After an attack of acute biliary colic, the gall-bladder becomes distended with mucus and may grow to a large size with but few symptoms. If infection occurs, the signs will be those of acute cholecystitis with the presence of a distended palpable gall-bladder. Jaundice only occurs from associated catarrh or obstruction of the common or hepatic ducts.

CALCULUS IN COMMON DUCT.—

There is usually a history of previous attacks of biliary colic followed by transient jaundice. When a stone becomes

Gall-stones—Symptoms, *continued*.

impacted in the common duct, the jaundice rapidly becomes intense, with itching and pale motions, etc. Whilst at first complete, the obstruction later diminishes, so that there is a variation in the degree of jaundice from day to day. This variation is of great importance in diagnosis of jaundice from obstruction due to carcinoma. Infection soon ensues with a stone in the common duct, and rigors and intermittent fever from infective cholangitis occur.

Physical Signs.—

ENLARGEMENT OF LIVER.—Slight—Tender.

ENLARGEMENT OF GALL-BLADDER at ninth costal cartilage. Smooth and rounded. Points to right pubic spine. Moves with respiration. Can be moved laterally. May be due to mass of calculi, mucus, or pus.

This enlargement of the gall-bladder indicates blocking of the cystic duct, and there is in this case only slight jaundice.

WHEN THE COMMON DUCT IS BLOCKED, and in most chronic or recurrent cases, the gall-bladder is contracted.

If a stone produces marked jaundice it does not cause enlargement of the gall-bladder, and vice versa.

Courvoisier's Law.—"When the common duct is obstructed by a stone, dilation is rare; when the duct is obstructed by other causes, dilation is common." Great importance in diagnosis. Absence of enlargement with gall-stones is ascribed to previous inflammation causing adhesions and fibrosis.

COROLLARY TO THE LAW.—

In jaundice due to gall-stones the gall-bladder is small; when due to carcinoma it is usually enlarged.

EXCEPTIONS TO THE LAW.—

1. Where there is a stone or stricture of the cystic duct causing hydrops or empyema, together with the acute impaction of a stone in the common duct.
2. Where there is a stone in the cystic duct pressing upon the common duct.
3. Where there is distension of the gall-bladder by an acute inflammatory process with obstruction of the common duct by a stone.
4. Where there is chronic induration of the head of the pancreas with a stone in the common duct.
5. Where there is malignant disease of the common duct at any part of its course, or cancer of the head of the pancreas and a chronic sclerosing cholecystitis.

Diagnosis.—Usually follows from association of colic with jaundice, and there may be palpable gall-bladder or stone in fæces.

RENAL COLIC.—Pain radiates into pelvis and thigh; vesical irritation, crystals in urine.

LEAD COLIC.—Chronic constipation, blue line, etc.

GASTRIC ULCER.—Relation of pain to meals.

CANCER OF HEAD OF PANCREAS.—Fixed tumour present, loss of flesh, deep jaundice associated with enlargement of gall-bladder.

MEMBRANOUS COLITIS.—Casts and shreds of the colon are passed.

ABSCCESS OF LIVER, ASCARIDES, HYDATIDS.

CHOLECYSTOGRAPHY.—The gall-bladder can be demonstrated by X rays after the ingestion of keratin-coated capsules of sodium tetraiodophenolphthalein.

Clinical Groups.—(1) Those in which the stone passes and gives rise to colic and transient jaundice; (2) Those in which the stone becomes impacted and colic is not present, but further sequelæ result.

Impaction : its Complications and Sequelæ.—

1. IMPACTION OF STONE WITHOUT OTHER COMPLICATIONS.—

In neck of bladder, or cystic duct : Gall-bladder forms large fluid tumour.

In common bile-duct : Permanent jaundice, unless fistulous communication with gut is formed.

2. IMPACTION FOLLOWED BY SEPTIC SEQUELÆ.—Cholangitis and cholecystitis with rigors. Empyema of gall-bladder. Hepatic abscesses. Perforation of bile ducts and abscesses in neighbourhood. Passage of stone into peritoneal cavity. Septic peritonitis.

3. IMPACTION FOLLOWED BY ADHESION TO STOMACH OR GUT, with formation of fistula and passage of stone. Often no symptoms.

4. IMPACTION FOLLOWED BY ULCERATION AND INTESTINAL OBSTRUCTION.

5. IMPACTION FOLLOWED BY ADHESION TO AND ULCERATION THROUGH ANTERIOR ABDOMINAL WALL.

6. OBLITERATION OF GALL-BLADDER.

7. ULCERATION FOLLOWED BY CICATRIZATION AND STENOSIS OF DUCTS.

8. CARCINOMA resulting from irritation of stone.

9. CHRONIC PANCREATITIS from impaction in the ampulla of Vater.

Treatment.—

MEDICINAL AND DIETETIC.—

FOR COLIC.—Morphia, gr. $\frac{1}{4}$, cum atropine sulph., gr. $\frac{1}{16}$; hot bath; large quantity of water (warm), with sod. bicarb. and sod. salicyl., to promote flow of bile; inhalation of chloroform. Olive oil or glycerin is of doubtful utility.

FOR PREVENTION OF STONES.—Exercise. Diet.

SURGICAL TREATMENT is called for in : Enlarged gall-bladder—Persistent jaundice—Recurrent attacks of colic—Intermittent fever—Signs of local inflammation—Peritonitis.

Gall-stones—Surgical Treatment, *continued*.

STONES IN GALL-BLADDER.—Cholecystectomy, i.e., removal of the gall-bladder, is the operation of choice. It removes the diseased gall-bladder, makes recurrence of the stones less likely, and greatly shortens convalescence. Cholecystotomy, with drainage of the gall-bladder after removal of stones, should be reserved for cases with acute suppuration and dense adhesions, or for patients in bad condition in whom the larger operation would be dangerous.

STONE IN CYSTIC DUCT.—Push back and remove through the gall-bladder, or incise wall of duct, remove stone, and sew up.

STONE IN COMMON BILE-DUCT.—Push forward or back, or excise and sew up. If the stone is in the third part of the duct, this must be done by opening the second part of the duodenum and removing the stone through the posterior wall of the gut.

BILIARY FISTULA.**External.—**

CAUSES.—Gall-stones—Penetrating wounds of gall-bladder or ducts—Hepatic abscess (especially of traumatic origin)—Surgical treatment of cysts or abscess of liver—Cholecystotomy—Actinomycosis—Malignant disease—Congenital.

POSITION.—Usually at umbilicus or right hypochondrium. May be in hypogastrium or inguinal region.

SYMPTOMS.—Discharge of bile, mucus, blood, or pus. Quantity will depend on patency of ducts. If entire bile is discharged externally, patient emaciates and dies.

PROGNOSIS.—When due to malignant disease, abscess in depths of liver, or impermeable stricture—bad. Otherwise—good.

TREATMENT.—Keep sinus clean. Drain. Scrape and pack. Remove gall-bladder. Remove obstruction from common duct. Cholecystenterostomy.

Internal.—

CAUSED by adhesion to and ulceration into: Stomach—Colon—Duodenum—Pleura—Pelvis of kidney—Vagina—Portal vein—Encysted peritoneal cavities. Or by malignant infiltration of same organs.

SYMPTOMS.—Gall-stones may: (1) Be vomited; (2) Be voided per anum; (3) Cause intestinal obstruction; (4) Cause encysted peritoneal collection of fluid.

ABSCESS OF THE LIVER.**Causes.—**

1. **TRAUMATISM**—chiefly pyogenic cocci. Blows on hypochondrium. Penetrating wounds; From outside—From stomach (fish-bones, pins),

2. GALL-STONES—chiefly *B. coli communis*. Direct ulceration from gall-bladder or ducts. Indirect infection, especially when stone ulcerates in the common duct.
3. PARASITES.—Ascarides—Creep up duct from duodenum—Especially in children—Die and act as septic foreign body. Hydatid cyst. Distoma (very rare). Coccidia—Small multiple abscesses.
4. DIRECT EXTENSION from neighbouring inflammatory foci. Right empyema, peritonitis, right perinephritis, etc.
5. PYÆMIC CAUSES.—

SYSTEMIC, VIA THE HEPATIC ARTERY.—Occurring as part of a general pyæmia. Especially in septic inflammation of bones (cranium commonest), ulcerative endocarditis, septic diseases of lungs.

PORTAL, VIA THE PORTAL VEIN (pyogenic cocci, *B. coli communis*, *Amæba coli*, tubercle, actinomycosis).—Ulcers of stomach or duodenum—Appendicitis—Operation for piles—Septic inflammation of umbilical cord.

Tuberculous abscess of the liver is a single ragged cavity, and is generally secondary to hypertrophic tuberculous disease of the cæcum.

Actinomycotic abscess is honeycombed.
6. TYPHOID FEVER.—Direct extension up bile-ducts. By pyæphlebitis. Indirectly through a focus of suppuration.
7. TROPICAL ABSCESS.—

GEOGRAPHICAL DISTRIBUTION.—Commonest in tropics. Mediterranean littoral. Occasional in England.

CLIMATE AND SEASON.—Greatest moisture, and greatest daily variation in temperature.

RACE.—Europeans are more subject than natives.

SEX AND AGE.—Men to women as 30 to 1. Age 20 to 40.

ALCOHOL is great predisposing cause.

MALARIA may act as a predisposing cause, but tropical abscess often occurs where malaria is unknown, e.g., Chili.

DYSENTERY.—In 75 per cent of cases. *Amæba coli* found in stools and in the abscesses; often not found in pus at first aspiration, but may be found 2 or 3 days later. They are invariably found in scrapings from wall of abscess.

Pathology.—

- SINGLE.—Tropical, in 75 per cent—Gall-stones—Ascarides—Spreading from neighbouring suppuration.
- MULTIPLE in all other cases; typically the pyæmic.
- MAY OPEN into: Lungs—Pleura—Pericardium—Stomach—Intestine—Peritoneum—Right kidney pelvis—Vena cava—Externally.
- SITUATION.—Commonest in upper part and back of right lobe.

Abscess of the Liver, *continued*.

Symptoms.—Often latent until rupture in tropical abscess.

Prominence, or bulging, in hypochondrium. Redness and oedema of skin.

Dull aching PAIN over liver. Sharp pain indicates perihepatitis.

ENLARGEMENT OF LIVER.—Swelling moves with respiration.

Fluctuation is rarely felt. Liver is tender.

MUDDY COMPLEXION.—Slight jaundice.

AUSCULTATION.—Friction sounds over liver. Signs of pleurisy at base of right lung. Crepitations at base of right lung.

Splashing sounds when abscess has burst into the pleura.

Enlargement of liver dullness, generally upwards. Stomach, colon, and right kidney pushed down. Pain in right scapula and shoulder. Cough (from irritation of phrenic or invasion of lung). *Amæba coli* may be present in sputum. [Dyspnoea from encroachment on chest.

TEMPERATURE.—Hectic (with rigors) in cases of injury or pyæmia. Often normal in latent tropical abscess.

DIGESTIVE DISTURBANCES.—Vomiting, diarrhœa, constipation, etc.

Complications caused by abscess bursting :—

INTO STOMACH.—Vomiting of pus.

INTO INTESTINE, generally colon.—Pus per anum.

INTO PERITONEUM.—Fatal peritonitis.

INTO PELVIS OF RIGHT KIDNEY.—Very rare.

INTO INFERIOR VENA CAVA.—Fatal.

INTO GALL-BLADDER.—Pus by bowel. May recover.

INTO PLEURA.—Rare—Symptoms of rapidly-formed empyema.

INTO LUNG.—Signs of pleurisy—Cough. Expectoration of foul, dark pus, often much blood—*Amæba coli*. Seventy per cent of tropical cases in which this happens end well, but in pyæmic cases it is fatal.

INTO PERICARDIUM.—Rapidly fatal.

EXTERNALLY.—Between or below the costal cartilages.

Nervous System.—Attacks of melancholia or hypochondriasis. Delirium and coma at end.

Diagnosis.—

LATENCY.—Some cases are latent, and bursting of abscess is first sign.

SPECIAL SIGNS.—Pain in right hypochondrium—Pain in right shoulder—Muddy complexion—Jaundice (slight)—Enlarged liver—Raised temperature.

PRESENCE OF DYSENTERY, septic wounds of head, or any focus of suppuration, makes above symptoms more significant.

LOCALIZED PERIHEPATITIS may give pain like abscess, but there is no enlargement of liver, and symptoms are not so severe.

OTHER VARIETIES OF SUBPHRENIC ABSCESS (*see* p. 422).

ASPIRATION BY NEEDLE is justifiable only if positive result leads to immediate operation. It may show *Amœba coli*, hydatid hooklets, coccidia, actinomycosis, or thick pus like anchovy sauce.

Prognosis.—In single or non-pyæmic cases, mortality varies from 50 to 80 per cent.

Treatment.—Freely open after locating abscess with syringe.

If parietes are not adherent, pack sponges round, and sew parietes to liver before evacuation.

Knife of thermo-cautery is best to cut liver.

If abscess be in right lobe above margin of ribs, the thoracic wall must be incised.

If abscess communicates with pleural cavity, part of chest wall must be freely excised, and both cavities drained.

If empyema exists, but does not communicate with liver, then two separate openings are required.

If abscess burst into peritoneum, open at once, and if adhesions localize the mischief, then evacuation may be successful.

TREATMENT OF AMŒBIC ABSCESS.—

Aspirate through large bone needle, and wash out abscess with quinine, leaving in half as much as pus taken out. Only perform transpleural drainage if aspiration fails to clear up the abscess.

Give emetine bismuth iodide in gelatin-coated capsules internally.

HYDATID CYSTS.

Distribution.—Common in Australia and Iceland. Commoner in London than in Scotland or provinces.

SITUATION IN LIVER.—Any part or surface may be involved. Hydatids of liver form 57 per cent of hydatid disease.

Symptoms.—

HEPATIC TUMOUR.—On the superior surface extending upward, liver pushed down. On the inferior surface extending downward, liver pushed up. Fluctuation, or elasticity, with 'hydatid fremitus'.

PRESSURE SYMPTOMS.—

Upon lung—Dyspnoea.

Upon digestive organs—Pain, vomiting, etc.

Upon blood-vessels—Œdema, ascites, piles.

Upon peritoneum—Localized peritonitis, pain.

Jaundice is rare—From pressure, or bursting into bile-duct.

RUPTURE.—

Into alimentary canal—Spontaneous cure.

Into peritoneum—Shock, collapse, urticarial rash.

Into pleura or lung—Pleurisy or pneumonia, possible expectoration of cysts.

Into pericardium—Rapidly fatal.

Into gall-bladder—Colic and jaundice.

Hydatid Cysts—Symptoms, *continued*.

Into pelvis of kidney, bladder, vena cava, portal vein.

Externally—Fistula.

SUPPURATION.—May result from injury, from presence of other septic focus, from pyæmia. Forms hepatic abscess with usual signs.

SPONTANEOUS CURE.—Parasite dies, fluid is absorbed, inert pultaceous material remains encapsuled. Cyst may become calcified. Cyst may be filled with bile, and then cured.

HÆMORRHAGE into the sac may follow rupture, and may prove fatal.

COMPOSITION OF HYDATID FLUID.—Neutral reaction. Sp. gr. 1006. About 2 per cent solids—salts, proteids, and extractives. Often contains hooklets. No albumin.

Diagnosis.—Slow-growing hepatic swelling, which: (a) is fluid or elastic; (b) moves with respiration. Aspiration shows hooklets. Complement fixation test. Blood invariably shows an eosinophilia.

DIFFERENTIAL DIAGNOSIS.—

1. **SOLID ENLARGEMENTS OF LIVER.**—In these: Solid feel. Signs of syphilis or malignant disease. Aspiration produces no fluid.
2. **SIMPLE CYSTS (very rare).**—Fluid has no hooklets, and is rich in albumin.
3. **ABSCESS.**—Rapid development. Tender to pressure. Throbbing pain. Rigors and temperature.
4. **ENLARGED GALL-BLADDER.**—Associated with colic and jaundice. Lateral movement possible.
5. **SUBPHRENIC HYDATID.**—Entire liver pushed down. Pleural cavity encroached on. Costal arches everted.
6. **SUBPHRENIC ABSCESS.**—Inferior border of liver displaced but unaltered in outline. Signs of inflammatory process. Aspiration produces pus or gas.
7. **CYST OR SWELLING OF RIGHT KIDNEY.**—Moves slightly with respiration. Colon is in front, not below.
8. **PLEURAL EFFUSION.**—Dullness is more diffuse and less localized. Constitutional symptoms are more marked.
9. **ANEURYSM OF HEPATIC ARTERY OR AORTA.**—Expansile pulsation. Blowing murmur. Jaundice always when hepatic artery is involved. Pain very great.
10. **OVARIAN CYST.**—Pelvic connections. Line of separation from liver.
11. **HYDATID CYST OF ABDOMINAL WALL.**—Liver felt moving independently.
12. **HYDATID OF BASE OF LUNG.**—Cough with blood-stained expectoration.
13. **PHANTOM TUMOUR.**
14. **LOCAL ABSCESS IN PERITONEUM.**
15. **ASCITES.**

Prognosis.—Bad when suppuration or rupture occurs—When cyst has to be reached through thorax.

Mortality after incision through abdomen, 10 per cent. After incision through thorax, 29 per cent.

Treatment.—Never aspirate. Expose the cyst, inject 2 per cent formalin to render contents sterile, and then endeavour to shell out the cyst. If this fails, sew the sac to the parietes (i.e., marsupialize), and then incise.

Other Cysts of the Liver— are.

SIMPLE SEROUS CYSTS.—May be large or small. Usually no symptoms. Fluid becomes solid on boiling. No hooklets. Probably lymphatic or bile mucous glands dilated.

TREAT as if hydatid.

MULTILOCULAR CYSTIC DISEASE.—Often associated with cystic kidneys. Probably mucoid degeneration of bile capillaries. Commonest in old people. Generally not recognized.

No treatment.

CYSTIC ADENOMA.—Localized glandular tumour containing cysts.

DERMOID CYSTS.—Very rare.

MOVABLE LIVER.

Causes.—

CONGENITAL.—Elongation of coronary and suspensory ligaments. Absence of coronary ligaments.

ACQUIRED.—Enlargement or growth of gall-bladder. Narrowing of outlet of thorax (tight lacing). Weight or traction of tumours or cysts. Laxity of abdomen, caused by many pregnancies. Fatty degeneration of suspensory ligament following peritonitis.

Symptoms.—Often associated with enteroptosis, movable kidney, or spleen. Dragging pains. Occasional jaundice. Tumour, shape of liver, in abdomen, which can be replaced in right hypochondrium. Resonance in hepatic region. Difficulty in walking. Digestive derangements. Almost always in women.

Treatment.—Belt. Discontinue corsets. Possibly hepatopexy.

SOLID ENLARGEMENTS OF THE LIVER.

Malformation.—A down-growing tongue of hepatic substance, usually connected with the anterior margin of the right lobe. Known as Riedel's lobe.

It is of importance only because it may be mistaken for gall-bladder, kidney, or other tumours.

Actinomycosis.—Rarely primary. Usually secondary to an intestinal infection, or an extension from the thorax. The liver is enlarged, with bossy outline, and is associated with signs of abdominal or pleuritic chronic inflammation. It softens and breaks down into an abscess, the pus of which may give the clue.

Prognosis and treatment are hopeless.

Solid Enlargements of Liver, *continued*.

Syphilis.—

DIFFUSE HEPATITIS.—Usually seen in congenital cases. The liver becomes hard, nodular, much enlarged from an interstitial fibrosis.

GUMMATA.—Occur in acquired or congenital forms. They cause a bossy enlargement of the surface, with few or no symptoms unless the portal fissure is encroached upon.

Amyloid Disease may result from syphilis or chronic suppuration.

Angioma is the only innocent new growth which is not rare. May be congenital or acquired, and it usually grows just beneath the capsule.

CONGENITAL CASES form large masses reaching to the navel which are not encapsuled.

ACQUIRED CASES occur at about 60 as multiple encapsuled tumours about $\frac{1}{2}$ to 1 in. across.

Carcinoma, as a primary growth, may arise from the hepatic cells, or from those of the bile-ducts. The mass is single. Secondary growths are common and multiple.

Sarcoma is very rare primarily, but common secondary to bone and melanotic deposits.

SYMPTOMS OF MALIGNANT ENLARGEMENT.—Nodular enlargement which encroaches upon the thorax and abdomen. Jaundice, emaciation, cachexia, and ascites are common, if death does not occur from the primary disease.

NEOPLASMS OF GALL-BLADDER AND DUCTS.

Carcinoma is common. Sarcoma, papilloma, and fibroma are very rare.

Carcinoma of Gall-Bladder.—

PATHOLOGY.—Generally scirrhus. Columnar-celled—from epithelial lining. Spheroidal-celled—from mucous glands. 90 per cent associated with gall-stones. Growth begins in mucous membrane, and at first it is a localized growth.

SYMPTOMS.—

IN EARLY STAGE.—Very vague and indefinite.

IN ADVANCED STAGE.—

Jaundice in 70 per cent of cases. From impaction of calculus or growth, from invasion of ducts, from pressure of glands at portal fissure.

Pain.—Sharp and paroxysmal, or constant and gnawing.

Tumour.—Hard, nodular. Sometimes suppurating.

Loss of weight. Spontaneous hæmorrhages. Gastro-intestinal disturbances.

SEX.—Women are attacked three times more often than men.

AGE.—Between 50 and 60.

DIAGNOSIS from carcinoma of liver secondary to other growth ; carcinoma of pylorus or pancreas.

PROGNOSIS.—Life lasts few months to two years.

TREATMENT.—If diagnosed before infiltration of liver has begun, remove gall-bladder and resect adjacent part of liver.

Malignant Growths of Bile-ducts.—Columnar-celled carcinoma. Common bile-duct in duodenum is usual seat, but any other part may be affected.

Begins as a papillary or submucous growth. Constricts duct. Invades pancreas, duodenum, etc. Seldom larger than hazel nut or walnut.

No special relation to gall-stones. Both sexes equally affected.

SYMPTOMS.—Indefinite pains in area of eighth dorsal nerve. Gradual onset of jaundice with all its signs. Hæmorrhages—cutaneous and mucous. Skin becomes olive-green. Intense itching. Enlargement of liver and gall-bladder. Slow pulse. Cholæmia—drowsiness, vomiting, delirium.

DIAGNOSIS.—

FROM IMPACTED GALL-STONE.—History of colic. Duration not more than few months in cancer.

FROM CANCER OF HEAD OF PANCREAS.—Almost impossible.

PROGNOSIS.—Seldom live more than three months after jaundice has become established.

TREATMENT.—Cholecystenterostomy is the only possible operation in most cases. Results are bad: hæmorrhage is so very liable to occur in jaundiced subjects.

Removal of growth is very seldom possible.

CHAPTER XLIV.

AFFECTIONS OF THE PANCREAS
AND SPLEEN.

AFFECTIONS OF THE PANCREAS.*

Diabetes.—Is caused by total removal or destruction of the pancreas by atrophy or new growth.

Often associated with fatty and fibrous degeneration of pancreas. Interacinar pancreatitis, with destruction of certain special cells called the islands of Langerhans, is the lesion most frequently found in pancreatic diabetes.

Injury.—Is very rare, and then usually fatal.

A blood-cyst may form in the lesser peritoneal cavity, and in this pancreatic ferments are present.

Treat by opening and emptying from in front, with ligature of bleeding vessels and drainage from behind.

Pancreatic Calculus.—Very rare. Composed chiefly of carbonates. Causes colic, and is associated with diarrhoea, and often diabetes.

PANCREATITIS.

Etiology.—The relation of the pancreatic duct to the common bile-duct, the two having a common opening into the duodenum, makes any obstruction of the ampulla of Vater (the common opening) by a gall-stone likely to produce pancreatic obstruction and inflammation.

INJURY by an abdominal contusion or operation may lead to sub-acute or chronic pancreatitis.

BACTERIAL INFECTION.—Every case shows organisms present generally of the *B. coli* group. Protrypsin plus bacteria results in the formation of trypsin, and this produces rapid necrosis of the pancreas. The route of infection is via lymphatics from an infected gall-bladder.

Pathology.—

ABSENCE OF PANCREATIC DIGESTION, as shown by : (1) The presence of undigested meat fibres in a patient not suffering from diarrhoea ; (2) Abundant undigested fat in the motions, causing the pale stools.

FAT NECROSIS, i.e., a splitting up of fat into glycerin and fatty acids. The latter remain as opaque masses in the tissues, united to calcium salts. It is the result of the diffusion of the fat-splitting pancreatic ferment in the blood. It occurs chiefly in the abdominal fat, both visceral and parietal. It is common in acute and subacute pancreatitis, but rare in the chronic.

*Robson and Moynihan, *Diseases of the Pancreas*.

HÆMORRHAGE.—Is conspicuous and well marked in the majority of the acute cases. It occurs: (1) In the pancreas itself; (2) Into the peritoneal tissues around. It may be due to the action of the glycerin liberated by the fat-splitting process, and is often increased by coincident jaundice.

CRYSTALS IN THE URINE.—In many cases of obstructive and acute pancreatitis the urine yields a crop of fine yellow crystals when boiled with phenyl-hydrazine after oxidization (Cammidge).

Classification.—

1. ACUTE.—

a. **HÆMORRHAGIC:** (i) Ultra-acute, in which the hæmorrhage precedes the inflammation, the bleeding being profuse both within and outside the gland. (ii) Acute; inflammation precedes the hæmorrhage, which is less profuse and is distributed in patches throughout the gland.

b. **GANGRENOUS.**

c. **SUPPURATIVE** (diffuse).

2. SUBACUTE.—Abscess of the pancreas.

3. CHRONIC.—

a. Interstitial: (i) Interlobular. (ii) Interacinar.

b. Cirrhosis of the pancreas.

Acute Pancreatitis.—

PATHOLOGY.—Gangrene or extensive hæmorrhage into the pancreas, with marked fat necrosis.

ONSET is sudden, but may be preceded by a blow.

SEVERE PAIN, TENDERNESS, AND SWELLING in the epigastrium.

SHOCK profound, pulse small and quick, temperature subnormal.

SEVERE VOMITING AND MARKED CONSTIPATION.—The latter may yield to enemata and give place to diarrhœa.

Case presents signs and course of **ACUTE PERITONITIS** of an upper abdominal type, and ends fatally in about three days.

CYANOSIS.—Bluish colour of whole body.

DIAGNOSIS is seldom possible from ruptured viscus or acute high obstruction.

TREATMENT.—Median incision establishes the diagnosis by finding: (1) The swelling and hæmorrhage in the pancreatic region; (2) The fat necrosis. The organ should then be explored and drained by going through the gastrocolic omentum and opening the posterior wall of the lesser sac. If the condition of the patient justifies further interference the gall-bladder should be drained.

Sub-acute Pancreatitis.—

LESS SUDDEN IN ITS ONSET, and marked with much less collapse than the acute variety.

VOMITING is not so severe.

DIARRHŒA becomes prominent, blood and pus passed in stools.

A VERY IRREGULAR TEMPERATURE, rising to 103–105° F. in the evening.

Sub-acute Pancreatitis, *continued*.

LOSS OF FLESH very rapid.

MARKED TENDERNESS.

DEFINITE SWELLING OR ABSCESS may form over pancreas. THE ABSCESS may track: (1) Up as a subphrenic; (2) Out as a perirenal; (3) Down as an iliac or psoas; or (4) Forwards as a peritoneal abscess.

COURSE.—Case lasts for weeks or months, and may recover.

TREATMENT.—Calomel and salol by mouth. Gastric lavage, and enemata.

OPERATION FOR ABSCESS.—Exploratory from in front. Draining behind or in front, after having packed off the peritoneal cavity.

Chronic Pancreatitis.—

CAUSES.—(1) Biliary catarrh or calculi in the termination of the common bile-duct, which also obstruct the duct of the pancreas; (2) Catarrh, ulcer, or sepsis in the duodenum; (3) A pre-existing acute or subacute pancreatitis.

ANATOMY.—Suppurative catarrh of the pancreatic ducts. Interstitial inflammation of the gland, with swelling at first and contraction later. Adhesions of duodenum, pylorus, and gall-bladder, with distention of the latter.

ONSET is usually gradual, but it may be sudden, with pain and jaundice.

PAIN may be both continuous and paroxysmal, and in both cases is in the epigastrium above the navel.

JAUNDICE is well marked, and deepens with each paroxysm of pain.

ASTHENIA, with loss of flesh and digestive disturbance, e.g., dyspepsia and vomiting, is well marked.

STOOLS are copious, loose, light-coloured, offensive, and contain free fat.

HECTIC FEVER with rigors is not infrequent.

THE HEAD OF THE PANCREAS can be felt as a hard tumour, and often the gall-bladder is distended.

VARIETIES.—

1. Syphilitic, found in the congenital disease in infants.
2. Interlobular. Affects the tissue between the lobules, and the islands of Langerhans escape. It is the common form arising from duct infection, and produces no glycosuria.
3. Interacinar. The inflammatory fibrous tissue penetrates the lobules and invades the islands of Langerhans. It is associated with diabetes.

DIAGNOSIS.—Is usually confused with chronic gall-stone cases, and recognized only during the operation. The tenderness in the mid-line, and tumour, may make it clear.

CANCER OF THE HEAD OF THE PANCREAS is often indistinguishable from this disease. The onset is in older people, is more painless, and the course more rapid.

COURSE.—May last for years unless glycosuria supervenes.

TREATMENT.—Any calculi in the biliary passages should be removed, and the gall-bladder anastomosed to the stomach or duodenum. This will relieve the jaundice, which is caused by pressure of the head of the pancreas on the common bile-duct.

PANCREATIC CYSTS.

CLASSIFICATION.—(1) Retention; (2) Proliferation; (3) Hydatid; (4) Hæmorrhagic; (5) Congenital; (6) Pseudo-cysts.

1. **RETENTION CYSTS.**—Caused by a calculus, interstitial fibrosis, pressure of a tumour of the duodenum, or kinking. Form the majority of simple cysts.
2. **PROLIFERATION CYSTS.**—Either adenomata, like ovarian tumours, or carcinomata.
3. **HYDATID CYSTS.**—Very rare.
4. **HÆMORRHAGIC.**—May be left after the absorption of blood from a cavity in or round the pancreas.
5. **CONGENITAL CYSTIC disease,** similar to that of the kidneys and liver.
6. **PSEUDO-CYSTS.**—Lying in front of the pancreas, often following trauma. Probably are simply formed by the filling of the lesser peritoneal sac with fluid exuded by injury of the pancreas.

ANATOMY.—Usually in the body of the gland and often of large size, holding fifteen to twenty litres. The inner wall is smooth, but in proliferation cysts there are sometimes papillomata. Dense adhesions are the rule.

FLUID is dark, viscid, and mucoid, and may contain proteolytic, emulsifying, and amylolytic ferments.

SYMPTOMS.—Epigastric pain. Dyspepsia, vomiting, and rapid loss of flesh. Alterations in the fæces or urine (fat or sugar) are exceptional. Absence of pancreatic secretion in the intestine is shown by Sahli's sign, viz., the fact that salol is not decomposed into salicylic and carbolic acids, whose presence in normal cases can be detected in the urine.

SIGNS.—An epigastric elastic swelling rather to the left of the mid-line. It is usually behind the stomach and transverse colon. The swelling is fixed, and has a transmitted pulsation. It may take four different courses in its growth:—

1. Between the stomach above and the colon below, both lying in front of it. This is much the commonest.
2. Above the stomach, behind the gastrohepatic omentum.
3. Into the layers of the transverse mesocolon.
4. Below the transverse colon.

When it becomes large it fills the whole abdomen. It is usually fixed, and moves very little with respiration.

DIAGNOSIS.—From cysts of the left kidney, liver, spleen, mesentery, omentum, and ovary, and from abdominal aneurysm (palpate in knee-elbow position).

Pancreatic Cysts, *continued*.**TREATMENT.—**

EXTIRPATION, if possible.

EVACUATION AND DRAINAGE.—Marsupialize first, as fluid has marked digestive properties and must not be allowed to escape into general peritoneal cavity. Protect skin with mineral fat. If cyst cannot be marsupialized, aspirate, pack off, and drain.

NEW GROWTHS OF THE PANCREAS.

Carcinoma.—May be scirrhus, encephaloid, columnar, or colloid. Usually in the head of the gland. It spreads thence into the bile-duct, duodenum, colon, ureter, portal vein.

SYMPTOMS.—Pain is gradual in onset, but usually severe. Jaundice, with enlargement of the gall-bladder, is chronic, very deep, and often accompanied by enlargements of the liver. Tumour is felt only in about a quarter of the cases. Rapid wasting, vomiting, copious foul stools containing undigested fat and muscle fibre.

COMPLICATIONS.—In addition to the usual (1) Biliary obstruction, there may be: (2) Pyloric obstruction; or (3) Ascites from pressure on the vena cava and portal vein.

DIAGNOSIS.—FROM GALL-STONES, by the painless onset of jaundice, the enlargement of the gall-bladder, and the rapid emaciation.

TREATMENT.—Anastomosing the gall-bladder to the duodenum or stomach will relieve the jaundice.

AFFECTIONS OF THE SPLEEN.**Congenital Abnormalities.—**

ABSENCE very rare.

PRESENCE OF ACCESSORY SPLEENS or splenuli in the gastro-splenic or great omentum.

Effects of Removal.—

BLOOD CHANGES.—Increase of leucocytes, decrease of red cells; diminution of hæmoglobin. These changes are most marked two or three months after removal.

LYMPHATICS.—The lymph-glands often become enlarged, and lymph-nodes appear in the mesentery and omentum where they did not exist before.

BONE-MARROW.—The activity of the cellular changes in the bone-marrow is greatly increased.

GENERAL.—Slight pyrexia, thirst, polyuria, and abdominal tenderness. The effects are less marked in young patients than in old.

Movable Spleen.—

CAUSES.—(1) Elongation or rupture of supporting peritoneal folds; (2) Increased size of the spleen; (3) Glénard's disease; (4) Tight lacing.

RESULTS.—

DISPLACEMENT.—The movable spleen may lie in any position, and may even occupy the sac of an inguinal hernia. Left iliac fossa and floor of pelvis behind uterus are perhaps the positions which most often cause errors in diagnosis.

ROTATION.—Axial rotation often accompanies extreme displacement. It is usually a half turn or one whole turn (180° to 360°). Symptoms are produced similar to those of a twisted ovarian cyst. The splenic vessels become thrombosed, and adhesions usually fix the spleen in the position where rotation has occurred.

ENGORGEMENT AND HÆMORRHAGE.—These may occur in any displaced spleen, but are specially likely in cases where the pedicle is twisted. Bleeding into the splenic substance may produce cysts.

CHANGES IN OTHER ORGANS.—The stomach and pancreas are dragged down, and the tail of the latter may form a part of the pedicle. Adhesions may form with any other viscera, especially with uterus and bladder in pelvic displacements.

TREATMENT.—

SPLENECTOMY in the majority of cases, i.e., in all when torsion, hæmorrhage, and adhesions have occurred.

SPLENOPEXY.—The spleen is sewn into a peritoneal pocket made over the inner surfaces of the 9th and 10th ribs.

Injuries of the Spleen.—

PUNCTURED WOUNDS, either by stabs or bullets, are very fatal from hæmorrhage.

TREATMENT.—Immediate laparotomy. Suture of the spleen in all cases except those of extensive laceration, in which the organ should be removed.

SUBCUTANEOUS RUPTURE.—

CAUSES are similar to those of ruptured liver, but in many cases there is a pre-existing condition of malarial or other splenic enlargement.

ANATOMY.—The spleen may be lacerated, torn in two, separated from its pedicle, or reduced to a pulp in its capsule. The left kidney and left lobe of the liver are often torn at the same time.

SYMPTOMS.—These are exactly similar to those of a ruptured liver, except that both cause and results are more marked on the left side than the right. There is often a well-marked latent period of hours or days between the initial pain and the subsequent signs of internal hæmorrhage. This is caused by clotting of the blood in the splenic vessels. Shifting dullness occurs in both flanks, but whilst the right flank can be made completely resonant, the left does not become so, because it is occupied by clotted blood which does not move. If untreated, half the cases die within one hour of injury—the majority die within 24 hours.

Subcutaneous Rupture of Spleen, *continued*.

TREATMENT.—Rapid exposure and clamping of the pedicle, followed by removal of the spleen, or by gauze packing and suturing in cases of partial rupture.

Diseases of the Spleen of Surgical Importance.—

ABSCCESS.—Is usually metastatic, arising from a septic embolus in the course of an acute fever, e.g., enteric, malaria, endocarditis, or portal pyæmia.

SYMPTOMS.—Rapid enlargement, with abdominal tenderness and rigidity in the left hypochondrium.

TREATMENT.—Drainage of the abscess if adherent to the parietes. Removal of the spleen if non-adherent.

TUBERCLE.—Very rarely tuberculosis affects the spleen alone and causes enlargement of the organ. In such cases splenectomy has been followed by good results.

CYSTS.—These may be (in the order of frequency) hydatid, hæmorrhagic, serous, or lymph. The signs are those of a cystic tumour in the left hypochondrium, and the treatment is splenectomy.

Tumours and Enlargements of the Spleen.—

GENERAL CHARACTERS.—A mass in the left hypochondrium appearing at tip of 9th costal cartilage. A sharp notched edge can often be felt. Moves with respiration. Dullness to percussion in front, but not behind. The upper margin disappears under the left costal margin, and is continuous with an area of thoracic dullness underlying the 9th, 10th, and 11th ribs behind.

NEW GROWTHS.—Primary new growths are generally rapidly growing lymphosarcomata. Form nodular tumours which may be painful. Treatment by removal.

PERNICIOUS ANÆMIA.—In this disease removal of the spleen tends to check excessive hæmolysis. Splenectomy should be preceded by careful 'step-ladder' transfusions of whole blood and removal of any septic foci in teeth, gall-bladder, or appendix. It will not cure the disease, but it prolongs life.

LEUKÆMIA.—Removal of the large spleen is usually fatal. But if the size of the spleen is first reduced by repeated applications of radium, then splenectomy has only a mortality of about 5 per cent.

It is not clear, however, that life is definitely prolonged.

SPLenic ANÆMIA OR BANTI'S DISEASE.—A chronic disease, with anæmia and leucopenia, associated with great enlargement of the spleen and a great tendency to hæmorrhage, especially from the stomach. In late stages, cirrhosis of the liver, jaundice, and ascites. The large spleen is often densely adherent to its surroundings. Splenectomy should be done as early as possible after preliminary radium treatment.

HÆMOLYTIC JAUNDICE.—A condition of jaundice without bile in the urine or clay-coloured fæces. May be congenital or acquired. Caused by excessive hæmolysis in the spleen. Blood-cells show excessive fragility in their reaction to salt solution. Splenectomy produces a permanent cure.

CHAPTER XLV.

AFFECTIONS OF THE KIDNEYS
AND URETERS.

CONGENITAL ABNORMALITIES.

Misplacements.—The kidney may be situated over the sacro-iliac joint, in the pelvis, or near the internal abdominal ring, whither it is probably dragged by the descent of the testis. This extreme displacement, which is very rare, may cause pain; when it occurs in the female sex, the pain is noticed especially during menstruation or pregnancy.

Malformation.—Division into two or many lobes, such as is normal in many animals, is comparatively common but of no clinical significance.

DOUBLE URETER, which may affect only the upper part or the whole length to the bladder, is fairly common.

SUPERNUMERARY VESSELS are common. The accessory renal artery usually comes off separately from the aorta below the main renal artery, and it may form a band over which the ureter becomes kinked, thus bringing about hydronephrosis.

Abnormalities in Number.—

ABSENCE OF ONE KIDNEY is excessively rare, probably less than 1 in 5000 cases.

CONGENITAL ATROPHY OF ONE KIDNEY is commoner than the above, and probably accounts for many cases which are included in that category. The kidney is represented by a fibrous mass, the ureter by a slender cord, and its vesical orifice by a dimple. In both this and the last the opposite kidney is hypertrophied to nearly double the normal size.

FUSION OF THE TWO KIDNEYS INTO A SINGLE MASS.—This is the most important of all the serious forms of congenital abnormality. It usually forms a horse-shoe viscus, the two kidneys being united at their lower pole, and generally being lower than normal. They may form a disc or S-shaped organ in one lumbar region or in the pelvis. Unlike the conditions when one kidney is atrophied or absent, it gives no evidence by cystoscopic examination, as the ureteric orifices are normal.

Cystic Disease, Sarcoma, and Hydronephrosis are occasionally congenital.

MOVABLE KIDNEY.**Degrees of Mobility.—**

1. **MOVABLE BEHIND THE PERITONEUM.**—‘Cinder-sifting mobility’. Either in or with its fatty capsule.
2. **FLOATING FORWARDS** as well as downwards, pushing the peritoneum before it.
3. **FLOATING WITH A DISTINCT MESONEPHROS.**

Etiology.—Women form 80 per cent of cases. Right kidney affected twelve times as often as left. Age at which symptoms are most marked, thirty to forty-five.

OFTEN FOLLOWS: Repeated pregnancy. Rapid emaciation which deprives the kidney of some of its fat capsule. Tight lacing, pushing down the liver and kidney. Fluxional hyperæmia associated with menstruation. Blow on the loin, or violent fall on the feet. Any enlargement of the kidney.

OFTEN ASSOCIATED WITH: Dilatation of the stomach—Enteroptosis—Melancholia.

Anatomy.—Scarcity or absence of perinephric fat. Laxity of peritoneum. Kidney is large, soft, and flabby. Renal vessels elongated.

Complications.—Dilated pelvis and hydronephrosis. Frequent kinking of the ureter. Pyelitis. Calculus, tumour, or other disease. Lower pole is tilted forward and inward.

Physical Signs.—Bimanual palpation can grasp the lower pole of the kidney. Abdominal tumour is formed when the kidney ‘floats’. It is generally just at the side of the umbilicus. Abnormal resonance in the loin.

Symptoms.—

PAIN.—Uncomfortable sense of weight or movement in the loin. Dragging pain in the abdomen and back, worse during the menstrual periods. Occasional crisis of acute agony if the pedicle becomes twisted.

GASTRO-INTESTINAL SYMPTOMS.—Dyspepsia and dilatation of the stomach, possibly due to a kinking of the duodenum. Colic with constipation, or rarely diarrhoea, from a dragging on the colon. Violent gastric crises of colic and vomiting from a dragging on a renal pedicle. Transient jaundice.

URINARY SYMPTOMS.—Slight albuminuria, pyuria, or hæmaturia from pyelitis or congestion. Polyuria, with ardent desire to micturate. Pain and scanty micturition, alternating with cessation of pain and polyuria, point to kinking of the ureter and hydronephrosis. Acute pain, passage of albumin, blood, and casts, point to torsion of the renal pedicle.

NERVE SYMPTOMS.—Hysteria, neurasthenia, melancholia, and hypochondriasis. Often worse during menstruation.

Diagnosis.—

FROM OTHER KIDNEY DISEASES, e.g., calculus, tubercle, or new growth. Here some distinct feature, e.g., crystals, bacilli, or hæmaturia, is present, and the course is more definite and rapid.

FROM OTHER FORMS OF CHRONIC ABDOMINAL PAIN.—Ovaritis or prolapsed ovaries. Uterine displacements. Recurrent appendicitis. Colic and constipation.

FROM OTHER ABDOMINAL SWELLINGS.—Abnormal right lobe of the liver. Gall-bladder distension or growth. Abnormal spleen. Growths of the cæcum. Ovarian tumour.

The fact that the kidney can be replaced in the loin, and the sickening pain felt on pressure on the kidney, are the main facts which prove a swelling to be displaced kidney.

Prognosis.—

PROSPECT OF CURE.—After inflammatory attacks. If the patient becomes fat. Sometimes after pregnancy.

PROSPECT OF BECOMING WORSE.—When associated with enteroptosis or hydronephrosis.

PROSPECT OF DANGER.—When associated with occurrence of renal crises; hydronephrosis or pyonephrosis; increasing constipation or appendicitis.

Treatment.—

PALLIATIVE.—Indicated in : (1) Mild cases ; (2) Cases associated with hysteria or hypochondriasis ; (3) General enteroptosis.

CONSISTS OF : Rest ; fattening diet. Belt with pad over kidney region : must be applied when the kidney is replaced.

RADICAL.—

1. NEPHROPEXY.—When symptoms are severe and not relieved by rest and belts. When hydronephrosis is present. When renal crises occur.

Results : 1-2 per cent die ; 90 per cent are cured of the pain ; 50 per cent are cured of gastro-intestinal symptoms.

2. NEPHRECTOMY.—Only when the kidney is disorganized by hydronephrosis or other disease.

INJURIES OF THE KIDNEY.

SUB-PARIETAL INJURIES.

Causes.—Direct violence ; crushes. Indirect violence ; impact of ribs, and muscular violence.

Occurrence.—Most commonly in men, and on the right side.

Anatomy.—Any of the following lesions may occur : Fatty capsule torn—perinephric hæmatoma. Peritoneum torn—especially in children. Subcapsular hæmorrhage. Rupture of the parenchyma—hæmatoma. Rupture of pelvis—bleeding and extravasation. Rupture of vessels. Thrombosis of vessels. Total pulping of kidney. Tearing of the kidney from its hilum. Necrosis or abscess of the kidney.

Sub-Parietal Injuries of the Kidney, *continued*.

Symptoms.—

COLLAPSE.—Long and profound. Often delayed when it is due to hæmorrhage. Vomiting.

ECCHYMOSIS.—In kidney region. Round the external abdominal ring and genitals.

PAIN.—In loin, radiating to testis and thigh. Pain and retraction of testis when clot is in the ureter.

TUMOUR.—In kidney region. Painful and ill-defined.

HÆMATURIA.—Commonest and most characteristic sign.

IT RESULTS FROM: (1) Rupture of the kidney; (2) Simple contusion or congestion; (3) Embolus or thrombosis; (4) Late inflammation; (5) Pre-existing cause, e.g., stone.

IT MAY BE ABSENT in ruptured kidney: (1) When rupture is superficial; (2) Vessels thrombosed; (3) Ureter plugged; (4) Kidney torn from the ureter.

CHARACTERS.—Profuse. Lasts many days, but may be intermittent. May have clot casts of the ureter.

MICTURITION.—Urgent desire for micturition. Pain and difficulty in the act. Pus and casts in the urine from late nephritis.

OLIGURIA OR ANURIA.—From shock. Injury of solitary kidney. Injury of both kidneys.

RETENTION OF URINE (rare).—Blood-clot in the bladder. Paralysis of abdominal muscles.

PERITONITIS.—When the peritoneum has been torn.

Results of severe injuries.—(1) DEATH from shock or hæmorrhage; (2) PERITONITIS; (3) INFLAMMATION and suppuration; (4) OCCLUSION OF URETERS, with hydronephrosis, pyonephrosis, or atrophy of the kidney; (5) EXTRAVASATION OF URINE; (6) TRAUMATIC NEPHRITIS; (7) PERINEPHRIC ABSCESS, due to bruising of colon and consequent *B. coli* infection.

Treatment.—

FOR SHOCK AND IN MAJORITY OF CASES.—Morphia and ergot. Purgation. Leiter's tubes.

FOR ACTIVE ARTERIAL HÆMORRHAGE.—Exploratory incision—Pack rupture with gauze. Wash out bladder if clots cannot pass. Cystotomy if bladder is full of clot.

IN SEVERE CASES.—Clamp pedicle. Remove kidney later if the shock is severe.

IN PERITONEAL EFFUSION.—Continue loin opening in front.

LUMBAR HÆMATOMA.—Open and drain.

INCISED AND PENETRATING WOUNDS.

Anatomy and Symptoms the same as above, with addition of: Wound—External hæmorrhage—Escape of urine.

Special Dangers.—Involvement of vessels or hilum. Wound of the peritoneum. Septic processes.

Treatment.—

WOUND.—Enlarge a small wound. Pack and drain a large one. Locate and remove any foreign body.

HÆMORRHAGE.—Expose the kidney. Sew, pack, or remove according to the degree of gravity.

PERINEPHRITIS. PERINEPHRIC ABSCESS.

Varieties.—Sclerosing—Lipomatous—Purulent.

Etiology.—

PRIMARY, i.e., UNCONNECTED WITH KIDNEY.—Traumatic—Sudden chill—Sequela of exanthemata.

SECONDARY TO SOME KIDNEY LESION.—Pyelitis—Pyelonephritis—Calculus—Cancer or tubercle—Disease of urethra, bladder, or prostate.

SECONDARY TO OTHER DISEASED ORGAN.—Pelvic inflammation. Disease of colon, appendix, gall-bladder, testis, urethra, rectum, uterus, liver, vertebræ.

Pathology.—

THE ABSCESS varies from small to very large. Often gangrenous walls.

PUS IS FÆCAL, or with fæcal odour. Softening and inflammation of kidney. Pus is usually behind kidney. May bulge peritoneum forward. Often dense adhesion between capsule and adipose tissue.

PUS MAY BURST into: Colon, small intestine, or stomach, pleural sac or lung (commonest); ureter, peritoneum, psoas, and thence to groin or buttock, loin.

THE NON-SUPPURATIVE VARIETIES result in dense fibrous adhesions or a fibro-fatty mass round the kidney, which is compressed and itself undergoes fatty degeneration.

Symptoms.—**1. WITHOUT SUPPURATION.**—

PAIN in loin.

STIFF SPINE inclined to tender side.

STIFFNESS IN WALKING and inclination to one side.

FLEXION OF THIGH AND LORDOSIS. Complete extension of thigh impossible. Flexion, abduction, and adduction can take place. Can stand on bad leg if body is bent over to bad side. Sometimes pain in knee.

ABSENCE OF SIGNS OF DISEASE OF HIP-JOINT.

2. WITH SUPPURATION.—

OBSTINATE CONSTIPATION.

CONSTITUTIONAL SYMPTOMS.—Temperature, 103°-104° F.

PAIN deep-seated, throbbing, radiating, and variable. Increased by pressure.

Perinephritis—Symptoms, *continued*.

INCREASED RESISTANCE and weight in loin. Dullness to percussion, fluctuation. Redness and oedema of flank.

RETRACTION OF TESTIS on affected side.

OEDEMA OF FOOT AND LEG on affected side.

OCCASIONAL ANÆSTHESIA OR PARALYSIS on affected side.

URINE.—Exceptionally contains blood or pus.

Diagnosis from :—

LUMBAGO.—No fever or swelling ; bilateral.

NEPHRALGIA.—Periodic. Local swelling absent. Hysteria.

ORGANIC DISEASE.—Better outline. No local heat or oedema.

SPINAL DISEASE.—No inclination to one side. Angular curvature.

MORBUS COXÆ.—Local signs of hip-joint disease.

SACRO-ILIAC DISEASE.—Local signs of sacro-iliac joint disease.

PSOAS ABSCESS.—Nearer mid-line. Spinal symptoms.

BLOOD EXTRAVASATION.—Relation to injury. Absence of fever.

APPENDICITIS.—Symptoms begin in iliac fossa.

FÆCAL ACCUMULATION.

Splenic or hepatic tumour, typhoid fever, empyema, pneumonia.

Diagnosis of Position.—

UPPER TRACT causes chest symptoms, e.g., pleurisy.

MIDDLE TRACT causes pain in groin, scrotum, with albuminuria.

LOWER TRACT causes pain in hip, thigh, and knee.

Prognosis.—Generally grave—30 per cent die. If opened early, good.

If abscess bursts into lung, colon, or ureter, there is still a chance.

If abscess bursts into pleura or peritoneum, very bad.

Treatment.—Hot fomentations. Ointment of iodide of lead, etc.

Morphia. Aperients, etc.

EARLY AND FREE INCISION, with drainage.

INTERSTITIAL NEPHRITIS.

(*Pyelonephritis without Suppuration.*)

Etiology.—(1) All conditions which give rise to obstruction,

(2) Traumatism ; (3) Drugs—turpentine, cantharides (?).

Pathology.—Thickened granular capsule. Excessive and adherent perinephric fat. Pelvis generally dilated or inflamed. Increase

of interstitial connective tissue, consequent distortion of tubules.

Often associated with resulting calculus. Old cases produce

‘cicatrical contracted kidney.’

Symptoms.—

1. CHRONIC FORM.—Arising from obstruction.

INSIDIOUS ONSET.—Generally no rigor or chill.

GENERAL MALAISE.—Small and rapid pulse. Drowsiness.

Loss of appetite. Flatulence. Rapid emaciation. Thirst, nausea, and vomiting.

HECTIC.—Evening temperature 100°–102° F. For days and weeks, with variations. Profuse sweats.

URINE.—Condition often obscured by cystitis, etc. Abundant.

Low specific gravity. Trace of albumin. Pus from pyelitis. REMISSIONS and relapses.

2. ACUTE TRAUMATIC NEPHRITIS.—

BEGINS with well-marked rigor.

HECTIC.—Well marked.

PAIN in loin generally one-sided. Very variable—acute or dull. Circumscribed or diffuse.

URINE.—Often suppressed. Blood. Red sandy deposit. Albumin and trace of pus.

TYPHOID STATE in severe infections.

Diagnosis.—

CHRONIC FORM.—From any form of chronic blood-poisoning.

ACUTE FORM.—From septicæmia or typhoid.

Prognosis.—Depends on cause of obstruction. Suppression is very dangerous.

Treatment.—

PROPHYLACTIC.—Overcome causes of retention. Careful instrumentation. Washing out decomposed urine from bladder.

PALLIATIVE.—Rest. Warmth. Aperients. Hot baths. Packs. Cupping and hot applications to loins. Morphia gr. $\frac{1}{4}$, atropine gr. $\frac{1}{100}$, for suppression. Quinine gr. v-x, with tinct. opii ℥ v-x, for hectic. Ergot for polyuria.

PYOGENIC INFECTIONS OF THE KIDNEY.

Varieties.—(1) Pyelitis; (2) Pyelonephritis; (3) Pyonephrosis; (4) Circumscribed renal abscess.

Bacteria.—Chiefly *B. coli communis*. Also streptococci, staphylococci, *B. tuberculosis*.

Predisposing Causes.—

OBSTRUCTIONS in urinary tract—e.g., phimosis, stricture, stone, enlarged prostate, movable kidney.

Direct Causes.—

1. EXTENSION FROM INFECTION ELSEWHERE IN URINARY TRACT.—Cystitis, urethritis.

2. GENERAL CAUSES.—Blood infections; pyæmic embolus; irritating drugs; parasites (*Bilharzia*, *Strongylus gigas*); pelvic inflammations; pregnancy. Exanthemata, diphtheria, typhoid.

1. PYELITIS.

Definition.—Inflammation and suppuration in pelvis of kidney.

Pathology.—Congestion and thickening of lining mucous membrane.

Pyelitis, continued.

Symptoms and Signs.—High temperature, malaise. Frequency of micturition. Intermittent discharge of pus in acid urine (if no co-existent cystitis). Pain and tenderness in loin. Often starts with a rigor. Microscopical examination of urine reveals pus and organisms.

Treatment.—Remove the cause. Give urotropine and potassium citrate. Bladder lavage and later irrigation of pelvis of kidney through ureteric catheter, but there should be no instrumentation in the acute stage.

2. PYELONEPHRITIS.

Definition.—Inflammation and suppuration of the kidney substance as well as of the pelvis.

Symptoms and Signs.—Acute onset with rigor and pain in back. Headache, occasional vomiting, dry mouth and thirst. Profuse sweating. Drowsy or later comatose. High temperature unless pending uræmia. Urine highly coloured and containing albumin, blood, and pus.

CHRONIC PYELONEPHRITIS.—Hectic temperature. Kidney enlarged and tender. Urine contains epithelial cells, casts, and pus; reaction acid in the early stages, alkaline in the late. Appetite and digestion bad. Slight delirium at night.

Treatment.—Remove the cause. Give bland fluids, urotropine, and potassium citrate. Hot packs to loin. Lavage of renal pelvis and bladder and instillation of mercurochrome (0.5 per cent aqueous). If suppuration supervenes, incise and drain pelvis of kidney (nephrostomy).

3. PYONEPHROSIS.

Definition.—Distension of pelvis and calices with pus. Due to retention and infection.

Etiology.—All causes of hydronephrosis (q.v.), with sepsis added. Especially calculous hydronephrosis. Most common on right side.

Pathology.—Kidney converted into a many-chambered pus sac. Septa between loculi consist of sclerosed parenchyma. Loculi may be separate or communicate with a central cavity. Cavity may be shut off from ureter. Contains pus, urine, and cheesy material. Calculi, either primary or secondary.

ADHESIONS form, and FISTULÆ may follow, into the loin, colon, stomach, or peritoneum.

Symptoms and Signs.—Generally proceeded by those of cystitis, pyelitis, or pyelonephritis. Rigors, diarrhoea, and sickness. Hectic temperature. Emaciation and prostration.

TUMOUR.—Enlarged tender swelling felt in loin. May be lobulated and fluctuating, and may vary in size.

PAIN.—Dull ache with acute exacerbations. Tenderness most marked in front.

URINE.—Scanty pyuria with a little blood. Often masked by cystitis.

Diagnosis.—Especially from hydronephrosis, perinephric abscess, pyelonephritis, or tubercle of kidney.

Prognosis.—Depends on condition of other kidney.

Treatment.—

1. REMOVE THE CAUSE, e.g., stricture, enlarged prostate, stone in bladder, etc.
2. TREAT CYSTITIS.
3. OPERATION when diagnosis is plain.

OPERATIVE TREATMENT.—

1. NEPHROTOMY, with drainage. Remove calculus and break down septa.
2. NEPHRECTOMY in cases where nephrotomy has failed or when kidney is hopelessly disorganized.

4. CIRCUMSCRIBED RENAL ABSCESS.

Etiology.—Abscess of the kidney may occur: (1) In any of the conditions just described; (2) In pyæmia; (3) In general infective fevers.

Pathology.—Abscesses often multiple and located between the tubules. Pyramids are streaky white, due to infiltration with pus. In pyæmia the abscesses are preceded by infarcts. The more chronic varieties are probably tuberculous in origin.

Treatment.—Nephrostomy and drainage. Nephrectomy in the case of advanced and tuberculous abscesses.

HYDRONEPHROSIS.

Causes.—Some form of gradual or intermittent obstruction.

CONGENITAL.—Phimosis. Abnormalities of ureter. Torsion of penis. Abnormalities of the renal vessels.

ACQUIRED.—Urethral stricture. Prostatic enlargement. Vesical stone or new growths. Vesical systole (sustained). Pelvic tumours or displacements. Bands or adhesions of peritonitis. Ureteral stenosis from ureteritis. Ureteral calculus, valve, or pocket. Kinking of ureter from mobility. Traumatic obstruction.

Varieties.—(1) Thin-walled cyst—atrophy of parenchyma; (2) Hypertrophied parenchyma round dilated calices.

Pathology.—Different degrees of dilatation of pelvis and calices, with varying atrophy of parenchyma (*Fig. 145*). Fluid consists of water and sodium chloride. Cells, phosphates, albumin frequent. Cholesterin occasional.

Hydronephrosis, *continued*.

Symptoms and Signs.—Twice as common in women as in men. There are two clinical groups of cases :—

1. THOSE OF SLIGHT DEGREE, where there are : Little or no atrophy of renal parenchyma—No palpable tumour.

SYMPTOMS.—Occasional attacks of pain in the loin and scanty micturition. Relieved by alternating polyuria.

2. THOSE OF ADVANCED DEGREE.—Where there are :—
ATROPHY of the renal parenchyma.

LARGE PALPABLE TUMOUR.—Dull, large, with all the characters of a renal tumour. Fluctuates. Often lobulated. May contain several gallons of fluid.

PAIN.—Often absent. Occurs in back and along the ureter. Very severe if rupture occurs.

INTERMITTENCE.—Pain, tumour, and scanty urine alternate with ease, no tumour, and polyuria.

ANURIA OR URÆMIA occurs in the rare cases where the disease is bilateral.

PYELOGRAPHY.—A catheter is passed into the ureter and some fluid opaque to the X rays, e.g., 25 per cent solution of sodium bromide, is injected under low pressure into the pelvis

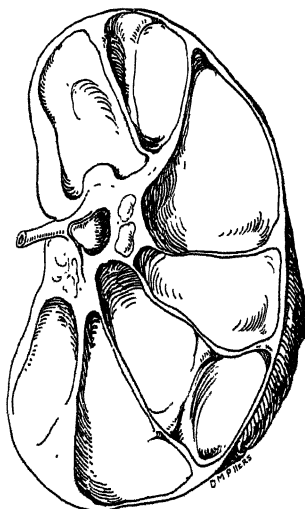


Fig. 145.—Diagram of kidney with stone impacted in pelvis, showing advanced hydronephrosis. ($\times \frac{1}{2}$)

of the kidney. A skiagram is taken (*Fig. 146*), and the outline of the pelvis and calices is shown in the picture.

INTRAVENOUS PYELOGRAPHY.—By the intravenous injection of certain organic iodides, of which the two best known are 'uroselectan' and 'abrodil', an X-ray picture of the cavities of the kidneys and ureters can be obtained without ureteral catheterization. This is of value when cystoscopy is impossible or when the ureter is blocked.

Diagnosis from: Renal abscess—Perinephric abscess—Perinephric extravasation—Pyonephrosis—Hydatid of kidney—Hydatid of liver—Ovarian cyst—Ascites.

Treatment.—None required in small cases with few symptoms.

NEPHROPEXY in cases resulting from mobility.

NEPHROTOMY.—Remove ureteral obstruction.

NEPHRECTOMY if parenchyma has atrophied, and provided the opposite kidney is functional.

RENAL TUBERCULOSIS.

Renal tuberculosis may be primary or secondary to tubercle elsewhere—e.g., lung—and primary or secondary in the genito-urinary tract itself.

Etiology.—

PREDISPOSING CAUSES.—General debility—Local debility.

AGE.—Miliary in young children: rare. Caseous in young adults. Rare in aged.

BOTH KIDNEYS generally affected in miliary tubercle. In caseous tubercle: in early stages 85 per cent unilateral, but in late stages 53 per cent bilateral.

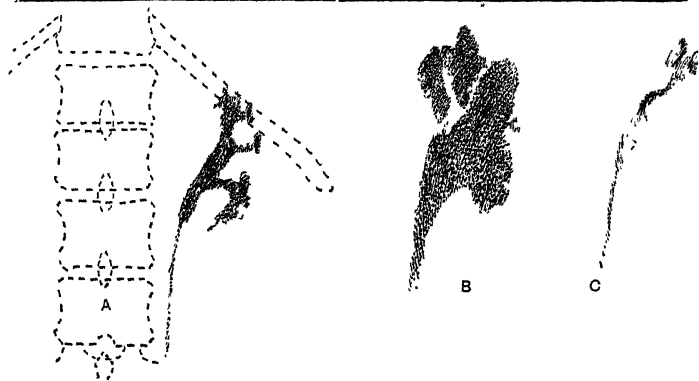


Fig. 146.—Pyelogram showing: A, Normal renal pelvis; B, Hydronephrosis with dilated ureter; C, Defect in filling in lower pole owing to this part of the pelvis being occupied by a tumour.

Renal Tuberculosis—Etiology, *continued*.

CHANNELS OF INFECTION.—

1. ASCENDING (secondary).—Rare.
2. HÆMATOGENOUS (primary).—Commonest.
3. LYMPHATIC.—Rare, from mediastinal lymph glands.

Pathology and Morbid Anatomy.—

1. ACUTE MILIARY TYPE.—Kidneys studded with miliary tubercles.
2. ULCERO-CAVERNOUS TYPE.—Starts at apex of a pyramid, and hollows out the pyramids from the pelvis outwards.
3. MASSIVE CASEOUS TYPE.—Whole kidney may be converted into a tuberculous pyonephrosis. This is an advanced stage of the ulcero-cavernous type.
4. DESCENDING TYPE, where infection is by blood-vessels.—Caseous masses develop in the cortex. Ureter and pelvis comparatively healthy.

URETER often blocked. It is usually thickened.

SECONDARY INFECTION by the colon bacillus and septic cocci occurs later.

Symptoms.—

PAIN.—Slight at first—Severe later—Attacks of colic from blocked ureter—Some tenderness on palpation.

TUMOUR.—Moderate size, often due to perinephritis—Ballottement well marked—May be lobulated.

URINE.—Polyuria—Acid—Pyuria and hæmaturia—Urea and phosphates diminished—Great variations due to blocking of ureter.

PYURIA.—Dirty grey pus in small quantity—Mixed with caseous masses and phosphatic débris.

HÆMATURIA.—Sometimes an initial symptom—Slight in amount—Sometimes clots moulded in ureter.

BACILLI.—Tubercle bacillus in small numbers and difficult of detection. Septic organisms become abundant late in the disease. Absence of other organisms in acid purulent urine points to tubercle.

CYSTOSCOPY.—Ureteral orifice is red, with pouting, swollen lips, or retracted. Methylene blue given as a hypodermic is not excreted, or excreted very slowly, by the diseased kidney.

PER RECTUM OR VAGINAM.—The thickened ureter may sometimes be felt.

ALBUMINURIA.—Always present when pelvis is diseased.

POLYURIA.—Very marked, especially at night. Is an early symptom.

DYSURIA.—Pain in neck of bladder. The earliest symptom, Sometimes due to phosphatic débris in bladder.

CONSTITUTIONAL.—Evening temperature raised to 100°–101° F.; if secondary sepsis has occurred, to 103°–104° F. Loss of flesh. Anæmia. Rigors and sweats in last stage.

THE OTHER KIDNEY may be enlarged and tender from hypertrophy without actually being diseased.

Complications.—Tuberculous infection of: (1) Opposite kidney in 50 per cent of cases; (2) Vesiculæ seminales, vas, epididymis; (3) Bladder and other organs. Varying degrees of perinephritis, with great thickening.

Diagnosis.—

FROM PYELONEPHRITIS.—History of case. Thickening of ureter. Presence of tubercle bacilli.

FROM CALCULUS OF KIDNEY.—Constitutional condition. Vesical irritation. Hæmaturia occurs during rest, and is slight. Tubercle bacilli found on examination, especially by inoculation experiments. X ray negative.

FROM NEW GROWTHS.—Hæmaturia is much less abundant. Constant pyuria. Hectic.

Diagnosis as to which Kidney.—Side of tenderness, pain, or tumour. If there is intermittent pyuria it is evidence that one kidney is healthy. Cystoscope and ureteral catheter. Indigo-carmin test.

Prognosis.—May last five years. Secondary pyogenic infection is the gravest complication. Occasionally undergoes spontaneous cure. Operative prognosis is about 20 per cent mortality. Ultimate result in successful cases is very good.

Treatment.—

GENERAL.—Diet, climate, etc.

OPERATIVE TREATMENT.—

1. **NEPHRECTOMY.**—Where opposite kidney is sound. Operation of emergency for hæmorrhage, colic, pyonephrosis. Useless when advanced tubercle exists elsewhere.
2. **NEPHRO-URETERECTOMY.**—When ureter is diseased.
3. **NEPHROTOMY.**—Where pyonephrosis is chief symptom. Where other kidney is uncertain.
4. **PARTIAL NEPHRECTOMY.**—When disease is limited to a part of the kidney.

RENAL CALCULUS.

Structure.—

PRIMARY. —Uric acid	} In acid urine.
Urates of soda or ammonia	
Oxalate of lime	
Phosphate of lime	} In alkaline urine.
Carbonate of lime	
Cystin	} In acid urine, but all rare.
Xanthin	
Indigo	

Renal Calculus—Structure, *continued*.

SECONDARY (to septic processes).—

Mixed phosphates	} From alkaline urine.
Phosphates of ammonia and magnesia	
Carbonate of lime	

LARGE CALCULI consist of secondary deposits on primary nuclei.

NUCLEUS.—Urate of ammonia when formed in infancy. Uric acid, in adults. Oxalate of lime, after forty. Bacteria—only exceptionally.

NUMBER.—Oxalate generally single. May be up to 200.

PROPORTION OF DIFFERENT VARIETIES.—Uric acid in 75 per cent of all calculi. Oxalate of lime in the majority of those removed, because they cause more suffering.

APPEARANCE AND CONSISTENCE (*Figs. 147 and 149*).—

Uric acid—hard, smooth, fawn-red.

Urates—light yellow, soft, friable.

Oxalates—hard, rough, dark.

Phosphates—chalky, mortary.

Carbonate of lime—round, white, hard.

Cystin—soft, crystalline, yellowish green.

Xanthin—smooth, hard, cinnamon-red.

Situation.—Pelvis, calices, ureteral orifice, or parenchyma.

Etiology.—In both kidneys in 50 per cent of all cases.

AGE.—Found at all ages. Clinically very rare below ten years ; common between twenty and fifty.

SEX.—Slight preponderance of males.

HEREDITY.—In uric acid stone there is generally a well-marked family history.

SIDE.—Right and left equally affected.

HABITS.—Sedentary life and rich diet.

WATER.—Lime in drinking water.

CLIMATE.—More frequent in hot countries, because evaporation and sweating concentrate the urine.

INJURY.—May give rise to calculus round a blood-clot, or first give symptoms by moving a calculus that has been present.



Fig. 147.—Branching renal calculus removed from pelvis of kidney. ($\times \frac{1}{2}$.)

Pathogenesis.—

URIC ACID.—Especially before tenth and after fortieth year. Derived from nuclein. Acidity of urine. Rich diet, little exercise. Hepatic congestion. Gout. Pernicious anæmia, leukæmia.

URATES.—Especially in children. Concentrated urine, as in febrile conditions. Dyspepsia.

OXALATE OF LIME.—Commoner in men than women. Nervous, irritable temperament. Studious, sedentary habits. Malaria. Rhubarb, gooseberries, tomatoes, sorrel. Poor, vegetable diet. Excess of acid. Formed often from uric acid. Much lime in water is excreted as oxalate.

PHOSPHATE OF LIME AND PHOSPHATE OF MAGNESIUM.—Due to presence of fixed alkali in urine. Excess of alkaline food. Excess of lime in food. Granular kidney. Phthisis. Dyspepsia.

AMMONIO-MAGNESIC PHOSPHATE.—Due to inflammation producing ammoniacal urine.

CARBONATE OF LIME.—Same conditions as phosphates. Especially associated with pus.

CYSTIN.—Contains sulphur. Runs in families.

AGGLUTINATION OF CRYSTALS to form a stone can only take place in presence of a colloid substance, e.g., colouring matters of urine, mucus, pus, or albumin.

Pathology of Calculous Kidney.—**ASEPTIC CHANGES.—**

NEPHRITIS.—Desquamative, interstitial.

Hypertrophy first. Atrophy later, (1) from sclerosis, (2) from pressure of hydronephrosis. Hydronephrosis. Partial hydronephrosis. Increase and induration of fibro-fatty tissue. Kidney converted into lipomatous mass.

SEPTIC CHANGES.—Suppurative pyelonephritis, with secondary calculi. Pyonephrosis. Perinephritis and perinephric abscess. External or internal fistula.

CHANGES DUE TO PASSAGE DOWN URETER.—Impaction, ulceration, etc.

Symptoms.—**COLIC.—**

CAUSED BY: Passage of stone to bladder—symptoms will cease unless second stone forms or only a fragment of first is passed. Impaction of stone in pelvis. Passage of blood-clot or mucopus.

PAIN shoots down leg, testicle, groin, or bladder. Is paroxysmal. **RIGOR, VOMITING,** perspiration, collapse.

URINE is scanty, blood-stained. Frequent micturition, often scalding.

Renal Calculus—Symptoms—Colic, *continued*

Testicle is retracted and becomes tender.

Attack ends suddenly.

Stone may be passed soon or impacted in urethra.

PAIN OF A CONSTANT CHARACTER.—In loin, abdomen, in course of ureter, testicle, thigh, inner side of leg or foot. Dull ache up to lancinating pain. Much worse after movement. Often worse at menstrual periods. Uric acid—least pain. Oxalate—acute pain. Phosphates—great and unremitting pain.

REFLEX PAINS.—In opposite kidney. In bladder—frequent and painful micturition. In uterus and ovary (especially of same side). In testicle. In gastro-intestinal tract—colic, vomiting, and nausea.

HÆMATURIA.—Almost always present (microscopically if not otherwise). Often associated with pain or colic—generally profuse for two or three days after colic ceases. Caused or increased by movement. Abated or stopped by rest.

PYURIA.—Generally only slight or microscopical. Urine is acid, and pus deposits readily.

URINE.—Hyaline casts—Slight albumin—Pus, blood, crystals.

PHYSICAL EXAMINATION.—Can be felt in thin subjects very rarely. Tenderness and pricking pain on bimanual examination. Greater resistance of muscles on affected side.

URETERAL CATHETER and CYSTOSCOPE show: Œdema of one ureteral orifice. Difference of urine on two sides.

RADIOGRAPHY.—Oxalates give best shadows. Phosphates give dark shadows. Pure uric acid and urates give faint shadows.

Diagnosis.—**I. FROM OTHER RENAL DISEASES. —**

1. **RENAL TUBERCULOSIS.**—In this there are: Pain and hæmaturia, not influenced by rest. Colic occurring only when mucopus is passed. Tubercle bacilli in the urine, or other tuberculous lesions.
2. **RENAL TUMOURS.**—In these: Tumour rapidly grows. Hæmaturia is much more copious. Pain is more constant and less colicky.
3. **MOVABLE KIDNEY.**—In this: The kidney mobility can be felt. There is absence of crystals in the urine. The two conditions may co-exist.
4. **URETERITIS OR KINKING** or valve of the ureter.—In these: Intermittent hydronephrosis. Absence of crystals. The two conditions often co-exist.
5. **LITHIASIS.**—In this: Hæmaturia, pyuria, or albuminuria are rare and scanty. The symptoms rapidly disappear under suitable treatment with alkalis, piperazine, etc.
6. **NEPHRITIS.**—In this: Urine is of low specific gravity. Casts are frequent and constant. Crystals are rare. Pulse of high tension, and heart is hypertrophied.

II. FROM DISEASES OF OTHER ORGANS.—

1. LUMBAGO AND INTERCOSTAL NEURALGIA.—In these : The pain is related to muscular effort. Generally bilateral. Muscles are fixed when the pain is present. Absence of destructive renal signs.
 2. SPINAL CARIES.—In this : Fixity, rigidity, tenderness, and pain of the spine. Urinary symptoms, if present, are associated with paraplegia.
 3. BILIARY COLIC.—In this : Relation to jaundice. Signs of tenderness or enlargement of the gall-bladder.
 4. APPENDICITIS of recurrent variety.—In this : Tenderness over McBurney's point. Tenderness per rectum. Intestinal symptoms.
 5. GASTRIC OR DUODENAL ULCER.—In these : Relation to food. Dyspepsia, vomiting.
- In all the above, except sometimes in (2), there is an absence of any urine changes.
6. DISEASE IN THE BLADDER—growth or stone. In these : Vesical irritation. Pain after micturition. Blood comes at the end of micturition. Cystoscope shows the disease.

IN CASES OF UNCERTAINTY, with marked symptoms.—
Exploratory incision. Incision into capsule and parenchyma.
Passage of ureteral bougie.

Prognosis.—

DANGER FROM : Impaction in ureter. Cicatrization and stenosis of ureter. Atrophy of kidney. Hydronephrosis. Suppurative pyelonephritis. Perinephric inflammation, suppuration. Fistula. Affection of opposite kidney. Anuria.

AFTER OPERATION.—Nephrolithotomy : 2 per cent die.
Nephrotomy : 23 per cent. Nephrectomy : 29 per cent.

Treatment.—

. PROPHYLACTIC.—

EXERCISE AND FRESH AIR.

AVOID malt liquors, port, champagne, vinegar or salads containing it, rich meats, excess of butcher's meat, sweet-breads, liver, kidneys.

PLENTY OF DILUENTS : Distilled water, Contrexéville or Vichy waters.

DRUGS.—

Alkalis, bicarbonates, potash, soda.

Citrate, tartrate, acetate of potash.

Carbonate and benzoate of lithia.

Piperazine

Sidonal

Hexamine

} Diuretics, solvents of uric acid, and antiseptics.

Renal Calculus—Treatment, *continued*.**OXALURIA.**—As above, but also :—

Avoid hard water, green fruits, asparagus, tomatoes, rhubarb, gooseberries, grapes.

Tonics, e.g., iron, strychnine, and quinine.

PHOSPHATURIA.—Treat neurasthenia and dyspepsia. Acids. Tonics.**SECONDARY CALCULI.**—Aseptic precautions. Avoid mineral waters. Hexamine, etc.**PALLIATIVE TREATMENT.**—For pain and colic: Morphia. Hot bath. Opium and belladonna fomentations. Alkaline drinks.**RADICAL OR SURGICAL TREATMENT.**—**NEPHROLITHOTOMY.**—Operation of choice. Symptoms which justify it are: Hæmaturia, crystals and pus, constant pain or colic.**NEPHROTOMY.**—For calculus pyonephrosis, and all septic conditions complicating calculi.**NEPHRECTOMY.**—If kidney is completely destroyed. After nephrotomy has been repeatedly necessary. For intractable fistula following nephrotomy.**PARTIAL NEPHRECTOMY.**—In suitable cases.

Lumbar incision when calculus is already in a fistula or perirenal abscess.

CALCULOUS ANURIA.**Etiology.**—**CAUSES.**—(1) Blocking of ureter by small stone; (2) Destruction of kidney by large stone.**IMPLIES** either only one functional kidney, or (rare) reflex suppression in the opposite kidney which has been injured.**POSITION OF IMPACTION.**—Renal pelvis 13 per cent; upper end of ureter 60 per cent; middle of ureter 13 per cent; lower end of ureter 20 per cent; bladder (large calculus) 4 per cent.**AGE AND SEX.**—May occur at any age or in either sex. Commonest in males over forty.**HISTORY.**—Generally: antecedent history of colic. Sometimes: disease of one kidney (other than calculus). Rarely: simultaneous blocking of both ureters; blocking of ureter of single kidney.**IMMEDIATE CAUSE.**—Some jolt, jar, or exercise.**Pathology.**—On one side there is absence, atrophy, disorganization, or hydronephrosis of the kidney, or an old impacted calculus.

On other side: Enlarged, congested kidney. Rarely hydro-nephrotic. Impacted calculus in pelvis or ureter.

Symptoms.—**ONSET.**—Pain (colic) on side last affected—subsides after one or two days. Or dull aching pain lasting throughout.

Rarely onset is insidious and without marked colic or pain. Ineffectual dysuria, or polyuria. Anuria may be complete, incomplete, or intermittent.

TOLERANT STAGE.—Complete anuria may last seven or ten days without uræmic symptoms.

If anuria ceases temporarily or permanently, a large quantity of low specific gravity urine is passed at once.

Anuria is rarely complete.

Urine passed in intervals is of low specific gravity, poor in urea, light colour. Rarely with blood, albumin, or casts.

Polyuria may occur and delay fatal result.

There may be constant desire to micturate.

Depression, insomnia, and digestive disturbances.

WHEN ASSOCIATED WITH HYDRONEPHROSIS.—Length of disease is much greater—lasts fifteen to twenty-five days. Generally history of repeated attacks of colic and anuria. Tumour, etc., can be felt.

URÆMIC STAGE.—Pulse full, slow, irregular. Epistaxis and cedema (due to venous stasis). Temperature low.

Profuse perspiration, pruritus, etc. Profuse salivation and expectoration. Constant and profuse vomiting, with constipation and meteorism.

Contraction of pupils. Muscular tremors, rarely amounting to convulsion. Complete depression of body and mind. Incessant restlessness. Drowsiness or semi-coma. Respiration slow and irregular.

Prognosis.—

In cases left to nature, 80 per cent die; 20 per cent recover by passage of calculus.

In cases operated on, 50 per cent recover.

During tolerant stage, i.e., before contraction of pupils and muscular tremors, there is always a chance of recovery.

Prognosis is worse in relapsing cases.

Diagnosis.—

IN STRAIGHTFORWARD CASES.—Renal colic on one side. History of colic on the opposite. Anuria.

IN OTHER CASES.—One kidney may have been destroyed without pain. Patients may have forgotten which side the colic was at first. Palpation of ureter may show tenderness. Rectal or vaginal examination may feel the stone. Otherwise open loin on side last affected.

FROM OTHER CONDITIONS.—

CANCER OF UTERUS, CANCER OF BLADDER, AND OTHER PELVIC TUMOURS (frequent causes of anuria).—Diagnosis by pelvic examination.

Calculus Anuria—Diagnosis, *continued*.

TRAUMATIC ANURIA.—By relation to injury.

ANURIA FOLLOWING OPERATIONS on lower urinary tract.—

Relation to the operation. Rigors, malaise.

BRIGHT'S DISEASE.—

Anuria is accompanied by headache, vomiting, coma, and convulsions. What urine there is, is dense, bloody, and solid with albumin. Secretion is resumed gradually.

AMYLOID DEGENERATION.—Long history of polyuria, œdema, etc.

HYSTERIA.—Other symptoms.

DRUGS (cantharides, turpentine, mercury).—History of their inception. Gradual onset. Urine bloody, and like Bright's disease.

RETENTION OF URINE is excluded by passing a catheter.

Treatment.—Operate as soon as diagnosis is clear. Open kidney last affected—On tender side—On side of greatest abdominal resistance.

NATURE OF OPERATION.—To remove stone, if possible, by nephrolithotomy. To establish lumbar fistula if stone cannot be removed. In cases where stone can be located in lower ureter, then ureterotomy.

TUMOURS OF THE KIDNEY.

Age.—Two periods of life when they are commonest: (1) Under five years; (2) Forty to fifty years.

Varieties.—Hypernephroma 70 per cent; carcinoma 7 per cent; others 23 per cent.

Distinctive Points of Kidney Swellings.—

1. Colon in front of tumour: either resonant or felt as a roll.
2. No space or resonance between tumour and spine.
3. Do not bulge behind, but only cause a fullness of the loin.
4. Absence of any sharp edges.
5. Slight or no movement with respiration.
6. Generally do not cross mid-line; do not invade pelvis; have a line of resonance between them and liver; except in extreme cases of hydronephrosis.
7. When they touch the anterior abdominal wall they do so about the level of the navel.
8. Varicocele of recent development is frequent.
9. Changes in urine or micturition.

Diagnosis from:—

LIVER TUMOUR OR ENLARGEMENT.—Moves with respiration. Fingers cannot get between it and ribs. No dullness in lumbar region. No intestine in front.

SPLEEN.—No bowel in front. Sharp edge—sometimes notched. Resonance between it and the spine. Moves with respiration.

SUPRARENAL.—Generally indistinguishable from renal. Generally not crossed by bowel.

OVARIAN.—Intestines behind. Grows from below upwards. Joined to the uterus. Loins are resonant. Urine is normal.

ENLARGED LYMPHATIC GLANDS.

FÆCAL ACCUMULATIONS.

MALIGNANT GROWTH OF LARGE INTESTINE.—Lacks shape of kidney. Symptoms referable to bowel. If large, is generally very fixed.

GROWTHS of mesentery, omentum, pancreas, gall-bladder.

PERINEPHRIC AND PARANEPHRIC TUMOURS.—Bulge out into the loin. Mobility is very restricted. Cannot be felt anteriorly.

MALIGNANT DISEASE OF KIDNEY.

Etiology.—A large proportion of cases are due to injury or irritation by a calculus.

Pathology.—

HYPERNEPHROMA (*see* p. 569).—Spheroidal and encapsuled. Metastases in lungs and bones. Proliferation of convoluted tubes. Spaces or tubes lined with renal epithelium. Probably a carcinoma of the renal tubules. Generally in adults, between forty and sixty.

CARCINOMA.—In old people, fifty to sixty-five. Commoner on right side and in men. Two forms: capsulated and diffuse. Invades neighbouring viscera, especially colon or duodenum, and vena cava. Alveolar structure, with blood cysts. Metastases in lungs and liver.

SARCOMA.—In children under five, and less often in adults, twenty to sixty. Grows to enormous size. Invades vena cava, ureter, and lymph glands. Encapsuled in early stages. Hæmorrhagic and pseudo-cysts.

MYOSARCOMA occurs especially in infants. Probably congenital.

Symptoms.—

HÆMATURIA.—Occurs in 80 per cent. First symptom in over 50 per cent. Spontaneous. Uninfluenced by repose or exertion. Profuse generally. Often occurs at intervals and lasts six days. Sometimes clot-moulds of ureter. Not so common in children.

TUMOUR.—First symptom in 25 per cent adult cases. First symptom in majority of children. Often difficult to detect, especially in upper pole. Absence of tenderness usually. Jaundice, constipation, and vomiting sometimes occur when right kidney is affected.

568 AFFECTIONS OF KIDNEYS AND URETERS

Malignant Disease of Kidney—Symptoms, *continued*.

PAIN.—Often absent in children. First symptom in 35 per cent adults. Begins in loin. Radiates to thorax, thighs, genitals. Uninfluenced by rest. Intermittent.

URINE.—Usually polyuria. Diminished urea and chlorides. Pus or albumin rare. May be frequent micturition.

VARICOCELE.—Comparatively sudden occurrence. Rapid development.

GENERAL SYMPTOMS.—Anæmia, emaciation, and 'cachexia'. Appear late (one or two years), and develop rapidly.

	CARCINOMA AND HYPERNEPHROMA	SARCOMA	
		ADULT	CHILD
Age	40-60	20-40	5
Hæmaturia ..	Profuse in 70%	Seldom profuse	Slight
Pain	Variable	Great	Slight
Cachexia ..	Early	Late	Early
Duration ..	3-3½ years	5-6 years	Less than 1 year
Metastasis ..	Usual	Rare	Rare

Diagnosis.—

1. WHERE TUMOUR IS PRESENT BUT NO HÆMATURIA :—
Malignant disease is probable : In children under ten and adults between forty and seventy. Rapid growth. No periodic lessening in size. Venous obstruction—swelling of the leg or varicocele. Enlarged glands.
2. WHERE HÆMATURIA IS PRESENT BUT NO TUMOUR :—
 - a. RENAL ORIGIN.—Blood thoroughly mixed with urine. Passage of worm-like clots. Cystoscopic examination.
 - b. NATURE OF RENAL DISEASE.—

Calculus.—Movement provokes hæmorrhage. Colic.

Tubercle.—Hæmaturia slight. Pyuria. Bacilli can be found. Patient is a young adult.

Nephritis.—Casts. Albumin in excess of blood.

RARE CONDITIONS.—'Essential hæmaturia' or angeioneurotic cases. 'Neuralgic hæmaturia'. Hæmophilia. Movable kidney.
3. WHERE TUMOUR AND HÆMATURIA CO-EXIST :—
Diagnosis from calculous disease and tuberculous disease (*see* pp. 559, 562). Polycystic kidney—polyuria, anuria, or uræmia; generally double. Cysts. Hydronephrosis caused by tumour of bladder.

Treatment.—

NEPHRECTOMY.—25 per cent of cases die, and of the 75 per cent recoveries the majority have recurrence within three years.

TRANSPERITONEAL for large growths. **LUMBAR** for small.

A COMBINATION of both incisions gives best results, because adhesions and pedicle can best be dealt with and drainage provided for.

Hypernephroma.—Hypernephroma or Grawitz's tumour, formerly believed to be a tumour arising in an adrenal rest, is probably a carcinoma arising from the renal tubules.

SITUATION.—It is usually connected with the kidney, developing as a nodule under the capsule, or as a distinct tumour in the kidney substance (*Fig. 148*). More rarely it may be found in connection with the ovary, testis, or uterus.

STRUCTURE.—It is a matter of dispute whether it is essentially an adenoma, carcinoma, or sarcoma. Probably it always begins as a benign adenoma, and subsequently becomes malignant. In its first stage it is definitely encapsuled; but later it breaks through the capsule, and invades the tissues round it, spreading along the veins and causing metastases. It is always of tubular structure, resembling the tissue of the adrenal cortex. The cells are markedly vacuolated, and contain notable quantities of fat, glycogen, and lecithin. The growth is very vascular, and occasionally contains giant cells.

SYMPTOMS.—These are usually those of a renal carcinoma, the following points being especially characteristic. Occur in middle age. There is often a long history of intermittent hæmaturia before the signs of a tumour occur. Later the hæmaturia becomes severe, and is accompanied by passage of clot-casts of the ureter and colic. Anæmia is well marked. Occasionally pigmentation of the skin occurs like that of Addison's disease.

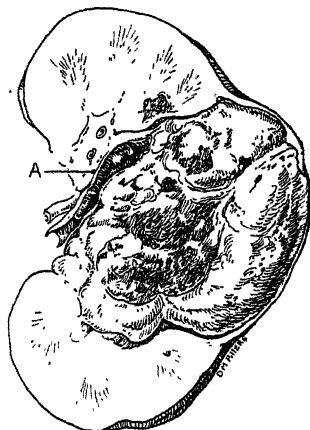


Fig. 148.—Section of kidney showing an early hypernephroma. A, Blood-clot in the ureter.

Malignant Disease of Kidney—Hypernephroma, *continued*.

METASTASIS.—Occurs by means of the veins. The lungs, liver, or bones may be affected. Secondary growth in the bone may be the first evidence of the disease. The skull, humerus, and femur are those most often affected.

PROGNOSIS AND TREATMENT are similar to those of carcinoma of the kidney.

BENIGN TUMOURS OF KIDNEY.

Adenoma.—Generally only size of pea and causes no symptoms. May have papillary and cystic formations.

Fibroma.

Lipoma, Osteoma, and Chondroma.

Angioma, Lymphangioma, and Myoma.

Cysts of the Kidney.—(1) Retention cysts in granular kidney; (2) Dermoid cysts (very rare); (3) Simple cysts; (4) Conglomerate cysts; (5) Hydatid cysts; (6) Paranephric cysts.

SIMPLE CYSTS.—Generally single, size varies from that of a cherry to a melon. At one pole of kidney. Filled with watery or colloid material. No symptoms except pressure. Treatment by partial nephrectomy.

THE LARGE POLYCYSTIC KIDNEY.

Pathology.—Weight 1 to 16 lb. Retains kidney shape. Multitude of cysts from pin's head upwards. Lined by cubical epithelium. Contains fluid or colloid material. Almost always bilateral. Often associated with cystic disease of liver and spleen. Hypertrophy of left ventricle common. In infants it is associated with various congenital defects.

THEORIES OF ORIGIN.—Inclusion of mesonephric elements (Wolffian body). Failure of union between excretory tubes and ducts. Feebleness of tubules, which renders them liable to dilatation. Cirrhosis or sclerosis, obstructing tubules. New growth, e.g., colloid adenoma.

Etiology.—Either infants—'congenital cystic abscess'—or between ages of twenty and eighty. Males more often than females.

Symptoms.—

VERY INSIDIOUS ONSET, resembling chronic Bright's disease

PAIN.—Dull aching in loins. Sense of weight and discomfort. Some tenderness.

TUMOUR on one or both sides in about 50 per cent.

GENERAL SYMPTOMS.—Anuria or polyuria sometimes. Intermittent albuminuria or hæmaturia.

Urine resembles that of chronic Bright's—Pale, low specific gravity, few casts, variable albumin. Nausea, vomiting, flatulence, etc. Headache, delirium, convulsions, coma. Cardiac and pulmonary symptoms, dyspnœa, bronchitis, etc. Cachexia in only a few cases.

Diagnosis.—Very difficult. Combination of tumours with symptoms of chronic Bright's.

Prognosis.—Slow progress towards uræmia (one to ten years).

Treatment.—Nephrectomy if only one kidney be affected, and only if that is causing great pain or bleeding.

TUMOURS OF RENAL PELVIS.

Commonest Varieties.—(1) Simple papilloma; (2) Epithelioma. Simple may become malignant.

Piece of growth may become detached and grafted on ureter or bladder. Often cause hydro- or hæmatonephrosis. Vary from size of pea to huge mass. Often associated with and due to calculus.

Symptoms.—

TUMOUR generally occurs, and is due to hydro- or hæmato-nephrosis. Sometimes tumour alternates with hæmaturia.

HÆMATURIA.—Earliest symptom. May be slight, intermittent, or fatal.

URINE.—May have albumin or pus. Varies in amount.

PAIN.—Unusual. May be colic due to passage of clots. May be due to distention.

GENERAL.—Anæmia, etc. Uræmia (late).

Diagnosis generally impossible from tumours of renal parenchyma. Presence of villous tufts in urine when cystoscope shows bladder normal.

Treatment.—Nephrectomy or nephro-ureterectomy.

SUBCUTANEOUS INJURIES OF URETERS.

Etiology.—Result generally from crushes, kicks, or falls. Possibly from compression of ureter against transverse vertebral processes. Possibly from a violent falling forward of the kidney. Often in young people (below twenty-five).

Pathology.—Ureter torn right across or lacerated. Peritoneum generally not torn.

If peritoneum is torn, urine is extravasated into peritoneal cavity.

If the tear in the ureter is extraperitoneal, a urinary extravasation into loin occurs.

If the injury does not tear through, but obstructs ureter, some form of nephrectasis results.

572 AFFECTIONS OF KIDNEYS AND URETERS

Subcutaneous Injuries of Ureters, *continued*.

Symptoms.—

HÆMATURIA.—Slight, severe, or absent.

URINE.—May be suppressed if both kidneys are injured.

PAIN.—As in kidney injuries.

TUMOUR.—If patient survives the accident, either an abdominal or loin tumour results.

If tumour is due to extravasation outside kidney, it appears in a few days.

If tumour is due to nephrectasis, it only develops in weeks
Suppuration occurs in tumour generally.

Diagnosis.—Is only apparent after the formation of the tumour following an injury.

Prognosis.—Is bad only when associated with severe injury to both kidneys, or rupture of the peritoneum.

Treatment.—Puncture is unsatisfactory.

LUMBAR INCISION and drainage are the best routine treatment.

SUTURE URETER if rent can be found. Do not ligature proximal end of ureter.

NEPHRECTOMY should only be a last resort in case of severe suppuration or intractable fistula.

OPERATION WOUNDS OF URETER.

Commonest in pelvic portion of the ureter. Near cervix uteri, or in the midst of adhesions or malignant growth. RESULT either in cutaneous or vaginal fistula, or peritonitis, or localized peritoneal urinary abscess.

Treatment.—

URETERO-URETERAL ANASTOMOSIS.—

DANGER is that of stenosis resulting from cicatrization.

METHODS.—(1) End to end—very careful and minute stitching ;

(2) End in end—unsatisfactory ; (3) Lateral implantation—best ; (4) Oblique end to end.

PRECAUTIONS.—Ends should be lightly ligatured. Search made for stone or stricture. Catheter retained in bladder. Drain retroperitoneal cases.

URETERAL GRAFTING.—When ureter is out of reach for minute plastic operations. When some length of ureter has been removed. Best into bladder. If not long enough for this, into colon rather than rectum or small intestine.

VAGINAL GRAFTING.—When time is of great importance, and when proximal end of ureter is long enough.

CUTANEOUS GRAFTING.—Through a stab-wound in the loin.

In all grafting methods there is great danger of septic infection of the kidney owing to the absence of the natural ureteral sphincter.

LIGATION OF BOTH ENDS OF THE URETER.—When time will allow no other method.

NEPHRECTOMY should only be secondary for relieving fistula or hydro- or pyonephrosis.

URETERITIS.

Primary.—Very rare. Calculus or injury.

Secondary.—Ascending—Descending—From pelvic inflammation—From mouth of a ureteral fistula.

Ascending Ureteritis.—Two factors : Distension—Inflammation.

CAUSES.—Those of cystitis and retention of urine. Also pelvic inflammation, uretero-vaginal fistula, pregnancy.

ANATOMY.—Three varieties :—

ACUTE.—Septic inflammation of mucous membrane. Little or no dilatation or induration.

CHRONIC DILATED FORM.—Ureter may be size of small intestine. Great tortuosity at both ends. Valves form at the bends. Canal is tortuous and obstructed. Little or no peri-ureteritis. Great increase of muscular tissue of ureter. Often cysts in mucous membrane.

FIBROUS TYPE.—Intimately adherent dense mass of peri-ureteral tissue. Ureter straight, thickened, and indurated. All coats inflamed, with excess of fibrous tissue. Strictures are long, rigid, and almost impermeable, or may be annular. Often associated with single pyonephrosis.

CONDITION OF URETERO-VESICAL ORIFICE.—Generally contracted. Sometimes dilated. Valve is destroyed by : (1) Mechanical effects of retention ; (2) Inflammatory effects of cystitis.

OBSTRUCTION OF URETER BY VALVES OR STRICTURE.

Causes of Valve Formation.—Temporary obstruction (e.g., pregnancy, etc.) causes kinking and dilatation of renal pelvis. Dilated pouch of renal pelvis may press on the ureter. Inflammatory dilatation in uretero-pyelitis. Enfolding of mucous membrane round a stone.

Causes of Stricture.—

CONGENITAL.—Generally close to renal pelvis. By aberrant blood-vessels.

ACQUIRED.—Injury. Cicatrices following ulceration. Impaction of calculus. Ureteritis.

Symptoms.—Commonest in females about thirty and in right ureter.

TUMOUR, either kidney or ureter.

374 AFFECTIONS OF KIDNEYS AND URETERS

Ureteral Obstruction—Symptoms, *continued*.

PAIN recurring at intervals of weeks. Acute, resembling renal colic. Dull aching in loin in intervals.

URINE may contain Pus, or CRYSTALS, or BLOOD.

TENDERNESS on bimanual examination, reduction of tumour, and filling of bladder.

BLADDER.—Frequency of micturition. Inability to retain water. Pain on passing water.

STRICTURE can sometimes be felt per vaginam or felt with the ureteral catheter.

Treatment.—Exploratory nephrotomy. Pass bougie from above, if possible. Pass bougie from below.

1. If stricture or valve exist at junction of pelvis and ureter : Longitudinal incision. Sewn together as transverse incision.
2. If the valve is caused by ureter opening high up into dilated pelvis : Divide ureter and sac down to lowest point, and sew edges together.
3. When a high oblique junction of ureter to hydronephrosis coexists with a stricture : Excise the stricture. Unite the lower end of ureter with lowest part of dilated pelvis. Split the end of the ureter before sewing it in its new position (Küster's operation).
4. When stricture is in the pelvis : Ureterotomy with plastic operation or nephrectomy.
5. Lumbar fistula.
6. Colpo-ureterotresis—grafting the ureter into the vagina.
7. Uretero-ureteral anastomosis, or grafting into the opposite ureter.
8. Nephro-ureterectomy or nephrectomy, where ureter is past mending.

CALCULUS IN URETER.

Etiology.—In great majority of cases renal in origin. May form round foreign body, e.g., blood-clot. May remain *in situ* indefinitely, or be discharged within eighteen months, and kidney resume its functions.

SITUATION.—(1) Just below commencement of ureter; (2) At vesical orifice (especially in women); (3) At brim of pelvis.

Symptoms.—Colic. Pain shooting along ureter. Tenderness over ureter. Hæmaturia. Anuria (if opposite kidney is blocked or diseased). Abdominal tumour (persistent or intermittent). Urine contains crystals, blood, or pus. Prolapse of ureter into bladder. Skiagram shows stone.

Diagnosis.—In the majority of cases the symptoms are simply those of renal calculus, and diagnosis is complete only on lumbar exploration and passing ureteral sound.

In some cases the stone can be felt per rectum or vaginam.

FROM ENCYSTED VESICAL CALCULUS.—Impossible clinically.
FROM CYSTITIS.—In this: Urine is alkaline. Pus at beginning or end of micturition.

FROM URETERITIS.—Difficult in absence of history of colic.

FROM VESICAL TUBERCULOSIS.—In this: Tubercle in urine. Polyuria. Frequent micturition. Slight hæmaturia. Symptoms not relieved by rest.

FROM PROLAPSED INFLAMED OVARY.—Ovary lies behind broad ligament and at greater distance from vaginal wall. Stone is felt in antero-lateral fornix. Hardness and outline are more definite.

THE SKIAGRAM shows a shadow in the course of the ureter, but this has to be distinguished from that of calcareous iliac glands or that of an appendix concretion (the latter very rarely throws a shadow).

URETERAL CATHETERIZATION through the cystoscope not only shows which side is affected, but the end of the catheter may touch the stone and a waxed tip receives a scratched impression.

Prognosis.—

KIDNEY.—Atrophy if block is complete and permanent. Recovery if block is removed within six to eighteen months. Hydronephrosis if block is incomplete. Pyonephrosis if sepsis occurs.

LIFE.—Not affected if other kidney is good. Endangered by inflammation and suppuration of kidney, extravasation of urine, anuria if opposite kidney is bad.

Pathological Effects.—

ON URETER.—

ABOVE.—Thinned, dilated, sacculated, and tortuous. Or cedematous, inflamed, and ulcerated, with rupture.

AT THE POINT OF IMPACTION.—Ulceration and stricture.

BELOW.—Unchanged, or thickened and stenosed. Prolapse of ureteral orifice. Ulceration of stone into bladder.

ON PERI-URETERAL TISSUE.—Induration, inflammation. Abscess or fistula.

ON KIDNEY.—Any variety of atrophy—Inflammation—Cystic kidney—Hydro- or pyonephrosis—Perinephritis and suppuration—Fistula.

Treatment.—Except when causing anuria (*see* p. 564), the case should be kept under observation in order to note whether the stone is fixed or moving. In the latter case time should be given for natural expulsion.

IMPACTED NEAR THE KIDNEY.—Attempt to push back and remove through the renal pelvis. Failing this, removal through an incision in the ureter, which is then sewn up.

IMPACTED AT THE BRIM OF THE PELVIS.—Remove through a long oblique lumbar incision which is produced down in front of the iliac spine.

Calculus in Ureter—Treatment, *continued*.

IMPACTED AT THE ISCHIAL SPINE.—Distend the bladder and make a median sub-umbilical incision opening the cave of Retzius. Empty the bladder and separate it from the corresponding side of the pelvis, and work towards the spine of the ischium.

IMPACTED IN THE BLADDER WALL.—Remove through the bladder by a suprapubic operation. In women it may be done through the vagina, but this involves the risk of a vaginal fistula.

RENAL INSUFFICIENCY.

The incompetence of the kidneys to carry out their excretory functions. It may be absolute or only relative. Normally there exists more than twice as much kidney substance as is necessary for the vital economy. If by atrophy, disease, or blocking of the ureters some of the kidney substance is destroyed or rendered functionless, a limit is reached beyond which any further kidney loss will be fatal. This is a matter of great importance in all operations upon the kidneys, ureters, prostate, or bladder, because either by direct removal of kidney substance or by severe shock the line between relative and absolute insufficiency may be overstepped.

Methods of Estimating Renal Insufficiency.—**THE AMOUNT OF THE URINE AND ITS CONSTITUENTS PASSED IN TWELVE HOURS.—**

QUANTITY varies from 500 to 700 c.c.

UREA varies from 12 to 15 grm.

CHLORIDES vary from 5 to 6 grm.

Any diminution of these quantities below 30 per cent indicates the lowest limit of renal sufficiency.

UREA CONCENTRATION TEST.—This is the most practical test, and the one used more than any other before deciding on operative treatment. All fluid is withheld for six hours. A sample of urine is then collected. The patient is now given by mouth 15 grm. of urea in 100 c.c. water. Three specimens of urine are collected at hourly intervals and the urea in each is estimated. If amount is over 2.5 per cent, kidney function is good. If not less than 2.0 per cent, kidney function is probably adequate.

INDIGOCARMINE TEST.—This pigment may be given as an intramuscular or intravenous injection (4 c.c. of a 0.4 % solution). The blue should appear within seven minutes if given intravenously, or within half an hour if given intramuscularly. Its elimination ought to cease in twelve to twenty-four hours. Renal insufficiency is indicated by: (1) A late appearance of the blue in the urine; and (2) Prolonged elimination lasting more than three days.

CHROMOCYSTOSCOPY.—In normal cases, after indigocarmine injection the dye should be visible as a blue stream through both ureteric orifices within five to twenty minutes, being best seen thirty minutes later. The absence of one kidney or a blocked ureter is obviously demonstrated by this method.

PHENOLSULPHONEPHTHALEIN TEST.—An injection of 6 mgrm. of the dye is made, and the amount excreted within two hours estimated by colorimetric methods. The proportion of the original dose normally excreted in that time (60 per cent) is reduced when renal insufficiency exists.

ESTIMATION OF BLOOD UREA.—

Blood normally contains from 10 to 40 mgrm. of urea per 100 c.c. of blood.

It varies according to diet, fasting, and exercise.

It is tested by addition of the ferment urease (from Soya beans) to the blood, when the urea is split up, giving off nitrogen.

Any amount above 45 mgrm. per 100 c.c. indicates retention of urea, i.e. renal inefficiency.

In impending uræmia amount rises to 200 mgrm. or over.

Routine Method for Estimating Renal Insufficiency.—

The functional capacity of one or both kidneys cannot be estimated by any one test. Clinical examination is at least as valuable as any chemical test. The following is a good routine method.

CLINICAL EXAMINATION.—

History of vomiting attacks; whether appetite, especially for meat, is good; presence of abnormal thirst.

General appearance of patient; state of tongue.

Blood-pressure. State of arteries and heart.

Ordinary examination of urine. Large quantity and low specific gravity (i.e., below 1010) are signs of inefficiency.

CYSTOSCOPY AND UREA CONCENTRATION TEST.—

If the cystoscopy is to be commenced, say, at 1.30 p.m., at 10.45 a.m. the bladder is emptied and a draught of 15 grm. of urea in 100 c.c. of distilled water is swallowed.

At 11.45 the patient passes urine = Specimen A.

At 12.45 the patient passes urine again = Specimen B.

At 1.30 the cystoscope is passed, under an anæsthetic if necessary, a catheter introduced into each renal pelvis, and 2 c.c. of urine withdrawn from each kidney = Specimens C (r) and (l).

4 c.c. of a 0.4 % solution of indigocarmine is injected into a vein of the arm. The ureteric orifices are observed for the passage of the pigmented urine, and the time taken.

578 AFFECTIONS OF KIDNEYS AND URETERS

Routine Method for Estimating Renal Insufficiency, *continued*.

EXAMPLES ILLUSTRATING METHOD.—

BOTH KIDNEYS HEALTHY.—

Clinical Examination.—No vomiting attacks, no abnormal thirst, and a good appetite for meat. General appearance good. Tongue moist. Blood-pressure low; no arteriosclerosis or enlargement of the heart. Urine examination normal.

Cystoscopy, etc.—

Bladder and ureteric orifices normal.

Specimen A = 1.5 to 1.7 per cent of urea

Specimen B = 1.9 to 2.1 " "

Specimen C (r) = 2.0 to 2.2 " "

Specimen C (l) = 2.0 to 2.2 " "

Indigocarmine through each ureter in less than 7 minutes.

ONE OR BOTH KIDNEYS UNHEALTHY.—

Clinical Examination.—History of vomiting attacks, thirst, no appetite for meat. Cachectic appearance. Tongue dry. Blood-pressure high; thickened arteries and hypertrophied heart.

Cystoscopy, etc.—

Bladder or ureteric orifices may be abnormal.

Specimen A = 1.2 to 1.3 per cent of urea

Specimen B = 1.4 to 1.6 " "

Specimen C (r) = 1.4 to 1.5 " "

Specimen C (l) = 1.3 to 1.4 " "

No indigocarmine through either ureter in 10 minutes.

ONE KIDNEY HEALTHY, THE OTHER DISEASED.—

Clinical Examination.—May reveal nothing abnormal.

Cystoscopy, etc.—

May show diseased condition of one ureteric orifice

Specimen A = 1.5 to 1.7 per cent of urea

Specimen B = 1.9 to 2. " "

Specimen C (r) = 0.65 to 0.8 " "

Specimen C (l) = 2.5 to 3.0 " "

Indigocarmine through left ureter in 4 minutes, none through right ureter in 15 minutes.

Deduction is that right kidney is practically useless and can be removed with safety, as left kidney is 4 times as efficient as the right and is doing all the work.

CHAPTER XLVI.

THE DIAGNOSIS OF ABDOMINAL DISEASE.

ACUTE ABDOMINAL AFFECTIONS.

It is of the utmost importance that a clear idea should be obtained of the *general nature* of acute intra-abdominal lesions; it is often impossible to obtain any precise knowledge of the locality, position, and nature of the lesion until the abdomen is opened. In many cases, to wait for the signs necessary for a complete diagnosis will postpone treatment until it is useless. It is, for example, the utmost folly to wait for the full clinical picture of a ruptured gastric ulcer to be developed. A reasonable suspicion of such an event makes instant laparotomy imperative. There are other cases in which opening the abdomen subjects the patient to an unnecessary operation, but otherwise does but little harm, e.g., in renal or lead colic. And again, there exists a small group of cases in which an exploratory operation may turn the balance of the scale in a fatal direction. Such are cholera or acid intoxication. Thus the nature of the lesion with reference to the necessity for laparotomy should be the first and chief object sought, and for this purpose the following classification will be useful.

Classification of acute abdominal lesions.—

- I. **SUDDEN PERITONEAL INVASION.**—The peritoneal cavity is more or less suddenly attacked by the outpouring of septic or irritating fluid.

SIGNS AND SYMPTOMS common to all this group are:—

1. Sudden and very severe pain felt all over the abdomen.
2. Profound shock, which has little or no tendency to recovery, but slowly merges into the collapse of peritonitis.
3. Intense tenderness and rigidity of the abdominal wall.

VARIETIES: Ruptured stomach, duodenum, small intestine, large intestine, appendix, gall-bladder, urinary bladder, pyosalpinx, hydatid cyst, abscess; acute 'idiopathic' peritonitis, notably the pneumococcus variety.

- II. **HÆMORRHAGE INTO THE PERITONEAL CAVITY.**—Here the loss of blood is the cardinal fact, whilst shock and peritoneal invasion are of minor importance.

SIGNS AND SYMPTOMS:—

1. Pain and shock are moderate, and usually are strictly proportionate to the degree of traumatism, which is the common cause.

Acute Abdominal Affections—Classification, *continued*.

2. The signs of hæmorrhage: pallor, restlessness, rapid compressible pulse, and sighing respiration.
3. A steady progress of symptoms, e.g., rising pulse-rate and increasing distension, is the most noteworthy sign.
4. Evidence of free fluid in the flanks or pelvis.

VARIETIES: Ruptured liver, spleen, kidney, uterus, gravid tube, blood-vessels.

III. INTESTINAL OBSTRUCTION.—Here the peritoneal cavity is not affected at first, and shock therefore passes off before peritonitis sets in.**SIGNS AND SYMPTOMS:—**

1. Constipation is usually absolute from the first.
2. The vomiting of shock, which is often the first symptom in all acute abdominal lesions, merges into that incessant vomiting characteristic of obstruction.
3. Tenderness and abdominal rigidity are absent unless peritonitis is superadded.

VARIETIES.—Hernia, internal strangulation, volvulus, mesenteric thrombosis, obstruction by foreign bodies.

IV. TORSION, STRANGULATION, OR ACUTE INFLAMMATION OF A VISCUS.—Here the signs will be varied and indefinite, but more definitely localized than in the other groups.**SIGNS AND SYMPTOMS:—**

1. Shock is of less degree and more gradual onset than in the other groups.
2. Pain is severe, but usually preceded by premonitory symptoms of an intermittent nature.
3. Definite localization is possible, because the seat of the pain is over some abnormal swelling or area of resistance.

VARIETIES.—Acute intussusception, twisted renal pedicle, twisted splenic pedicle, twisted ovarian tumour, acute pancreatitis, torsion of the testis, strangulation of a solid viscus in a hernia, e.g., the ovary or omentum.

V. COLIC.—Here there is no primary inflammatory lesion, but merely pain due to distension of a duct or abnormal muscular spasm.**SIGNS AND SYMPTOMS:—**

1. Agonizing pain predominates the case. This is usually localized over the affected part and often has a characteristic radiating distribution, and is intermittent. It begins suddenly and ends suddenly.
2. Although the abdomen is often rigid, pressure on it relieves rather than aggravates the pain.
3. There is usually a history of some antecedent condition which is the cause of the colic, e.g., jaundice, urinary symptoms, or contact with lead.

VARIETIES.—Biliary colic, renal colic, lead colic, colitis, or other gut colic.

VI. NON-SURGICAL CONDITIONS, which may simulate any of the above. These hardly permit of any general description, except that the vomiting, diarrhoea, and pain are not correlated to signs of abdominal disease in the way which occurs in the other groups.

VARIETIES.—Cholera, acute irritant poisoning, crises of tabes dorsalis, basal pleuro-pneumonia, acute acid intoxication.

History.—The existence of any preceding illness or pain, and the exact character of this, are of the utmost importance.

DYSPEPSIA.—Pain directly after food in gastric ulcer. Pain one or two hours after food in duodenal ulcer. Indefinite digestive disturbances may precede pancreatitis, biliary colic, or almost any acute lesion. Occasionally a gastric, and much more frequently a duodenal, ulcer may perforate which has been quite latent.

CONSTIPATION of marked degree and increasing severity precedes rupture of a stercoral or malignant ulcer.

DIARRHŒA precedes the rupture of a tuberculous or dysenteric ulcer.

JAUNDICE in cases of gall-stone colic, ruptured gall-bladder, intestinal obstruction by gall-stones, and some cases of pancreatic disease.

DISORDERS OF MICTURITION.—Difficult, frequent, or painful micturition often precedes renal colic, renal crises, or ruptured urinary bladder.

PREVIOUS ATTACKS OF PAIN generally occur in the various forms of colic—biliary, renal, or lead—also in displaced kidney or spleen, or twisted ovarian cyst. Appendicitis also may have existed as recurrent attacks, but the fulminating attack which gives difficulty in diagnosis is usually the first.

LEAD HABITS, e.g., painting or colour-making, precede lead colic.

TRAUMATISM, if severe and direct, suggests a ruptured viscus. If less severe and indirect it may be the cause of a twisted viscus, biliary or renal colic, or a ruptured extra-uterine gestation.

MENSTRUAL HISTORY gives indications as to the possibility of some form of abnormal pregnancy or rupture of a pregnant uterus.

General Symptoms.—

PULSE is of increased rate in most cases. A normal pulse practically excludes all cases of ruptured viscera, peritonitis, intestinal obstruction, twisted viscera, or hæmorrhage, and points to the case being one of colic. A small, hard, wiry pulse is suggestive of sudden peritoneal invasion, and a rapid and compressible pulse of hæmorrhage. The slowing of the pulse indicates the passing off of shock; its increase in rate signifies a progressive lesion, and is of gravest import when associated with a falling temperature.

Acute Abdominal Affections—General Symptoms, *continued*.

TEMPERATURE is of very little value in early diagnosis, because it is so often practically normal in the gravest conditions, e.g., ruptured ulcer, intestinal obstruction, or colic. A high temperature which remains high suggests peritonitis of the less virulent type. An intermittent high temperature, with rigors, indicates suppuration in the biliary ducts, or possibly portal pyæmia. A low temperature indicates collapse or sudden peritoneal invasion or hæmorrhage. A sudden drop from a high to a subnormal temperature accompanies the perforation of a typhoid ulcer.

VOMITING as an initial symptom is of no significance, as it accompanies any condition of shock. If it persists, and increases, it indicates obstruction. Coming on late it suggests peritonitis. Blood-stained vomit is seen in stomach injuries and rarely in perforated ulcer. But continued vomiting is against the diagnosis of a gastric lesion, and the worst cases of perforated gastric ulcer never vomit at all.

CONSTIPATION of some degree accompanies most acute abdominal lesions. If after the lower bowel has emptied itself it is absolute and lasting, it indicates obstruction or peritonitis.

DIARRHŒA with blood and mucus accompanies intussusception, colitis, cholera, enteric fever, and irritant poisoning.

PAIN is common to all these cases. Its characters are important.

VERY SUDDEN ONSET: Ruptured viscus, biliary or renal colic.

ACUTE PAIN PRECEDED BY PREMONITORY SYMPTOMS: Strangulated hernia, intestinal obstruction, twisted viscus, pancreatitis.

DIFFUSE, but chiefly umbilical, is the common type in peritoneal invasion and obstruction.

LOCALIZED: Above the navel in gastric ulcer, pancreatitis, ruptured liver, gall-stone diseases, or ruptured spleen. Right iliac fossa in appendicitis. Hypogastrium in tubal gestation, pyosalpinx, or ruptured bladder. In the loin and referred to the inguinal region in twisted kidney and renal colic. Over the right rectus in gall-stones and duodenal ulcer.

OF INTERMITTENT CHARACTER in various forms of colic, in partial obstruction, and in acute intussusception.

The Abdomen.—

MOVEMENT is seldom quite natural.

FREE MOVEMENTS in colic, intestinal obstruction (early).

IMPAIRED MOVEMENTS in twisted viscus or pelvic lesions.

ABSENCE OF MOVEMENT characterizes all forms of peritoneal invasion, ruptured viscus, and hæmorrhage of traumatic origin.

RIGIDITY goes with impairment of movement, and gives more detailed information, thus:—

RIGIDITY OF THE UPPER ABDOMEN follows lesions of stomach, liver, gall-bladder or duct, pancreas, and spleen.

RIGIDITY OF THE LOWER ABDOMEN goes with appendicitis and pelvic lesions.

RIGIDITY MORE MARKED ON THE RIGHT SIDE with biliary, appendix, and duodenal lesions.

TENDERNESS and rigidity generally go together. A marked absence of tenderness, the patient pressing on his abdomen for relief, is suggestive of renal, biliary, or lead colic, or intestinal obstruction. The most acute tenderness is seen in cases of peritoneal invasion and ruptured viscus.

DISTENSION is rare as an early sign. Coming on within a few hours of the onset, it indicates a ruptured viscus, effusion of gas, fluid, or blood, and is then associated with tenderness and rigidity; or acute intestinal obstruction, especially volvulus, when rigidity and tenderness will be less marked.

PERCUSSION.—

SHIFTING DULLNESS in the flanks, especially if it increases in a few hours, indicates free fluid, blood, or visceral contents poured out from a ruptured viscus.

OBSCURED LIVER DULLNESS of rapid development indicates free gas from a ruptured stomach or gut. But if present from the outset it may be due to a distended colon. A normal liver dullness practically excludes free peritoneal gas.

TUMOUR is rarely present, and more rarely palpable. It is most significant in acute intussusception, being sausage-shaped, over the colon, and hardening during the attacks of pain. Displaced kidney or spleen, ovarian tumours, ruptured uterus, or distended gall-bladder may be felt.

Pelvic Examination.—

INSIDE THE RECTUM.—An intussusception or new growth may be felt. Marked ballooning suggests sigmoid disease or some form of pelvic peritonitis.

OUTSIDE THE RECTUM.—Right-sided inflammatory swelling is felt in many appendicitis cases. Or a hæmatocele may indicate a ruptured tube.

BY THE VAGINA.—An ovarian or tubal swelling, and the condition of the uterus, may be determined.

Progress of the Case.—This is of the utmost importance in the acute cases.

RAPID INCREASE OF SYMPTOMS, especially the pulse-rate, rigidity, and distension, indicates a visceral lesion. This is seen within one or two hours, and demands immediate laparotomy.

STEADY INCREASE, especially of distension and vomiting, indicates intestinal obstruction.

STEADY IMPROVEMENT is seen in shock without visceral lesion after injuries.

IMPROVEMENT FOLLOWED BY RISING PULSE-RATE indicates hæmorrhage coming on after the subsidence of shock.

SUDDEN RELIEF OF PAIN occurs after the passage of a calculus, and, in a less degree and later in the case, in the occurrence of gangrene in strangulation of intestine or other viscus.

Special Examination in Anomalous Cases.—

BLOOD-COUNT.—Marked leucocytosis, with increase in the relative proportion of polynuclear cells, suggests an acute infection, well resisted, i.e., an abscess.

BASE OF CHEST.—May show evidence of pleurisy or pneumonia, which causes pain very like that of abdominal disease.

THE URINE.—

CRYSTALS, BLOOD-CASTS, AND ALBUMIN suggest renal colic.

BILE PIGMENTS suggest biliary colic.

SUGAR—very rarely in pancreatitis.

INDICAN—acute obstruction of the small intestine.

CAMMIDGE'S CRYSTALS—in pancreatitis.

ACETONE OR DIACETIC ACID—in acid intoxication. This occurs generally in fat children, vomiting being the chief symptom.

A sweet smell in the breath should give the warning of the existence of this condition. Its recognition is of great importance, because an exploratory operation under an anæsthetic will probably end fatally.

THE FÆCES.—Contain blood and mucus in cholera, colitis, and intussusception. Large quantities of fat and undigested meat fibres in pancreatitis. Blood intimately mixed with the fæces in duodenal ulcer.

THE NERVOUS SYSTEM.—Absence of knee-jerks, pupils which do not react to light, suggest tabes, which may be causing some visceral crisis.

DIAGNOSIS OF CHRONIC ABDOMINAL DISEASE.

This group, including as it does a great number and variety of different conditions, presents the greatest difficulty in diagnosis; but in no district of the body is diagnosis more important, because the majority of the conditions are amenable to operative treatment. The diagnosis must always be accurate enough to answer the three questions: whether, when, and where to open the abdomen. It is worse than futile to do a laparotomy for obesity or spinal caries. Delay may be fatal in operating for carcinoma of the stomach or gut. And the operation will do more harm than good if, e.g., a suppurating kidney is opened through the peritoneal cavity. But in many cases it is impossible to do more than suspect the probable nature of a disease, so that it is of great importance to examine every case with the utmost thoroughness, ascertaining every possible fact before operation, but being prepared to find the nature of the disease quite different from that suspected, during the operation. To put the matter in another way, it is necessary to avoid two extremes: on the one hand, that of not troubling to diagnose the condition, but subjecting every abdominal condition to operation; and on the other, refusing to open the abdomen when diagnosis is impossible without exploration.

Classification.—

1. GENERAL ABDOMINAL DISTENSION.—Uniform enlargement. Fat, flatus, fæces, fluid. Large growth filling the abdomen. Phantom tumour.

2. LOCAL SWELLING.—

PARIETAL.—Epi-, inter-, or sub-parietal, according to its position outside, in, or inside the abdominal muscles.

VISCERAL.—

Hepatic	Colic	Uterine
Biliary	Omental	Ovarian
Splenic	Pancreatic	Broad ligament
Gastric	Renal	Testicular
Enteric	Perirenal	Vesical.

HERNIAL.—A viscus protruding through the parietes.

Inguinal	Umbilical
Femoral	Ventral.

3. LOCAL DISEASE WITHOUT SWELLING.—

DISORDERS OF DIGESTION in diseases of:—

Œsophagus	Small gut	Liver
Stomach	Large gut	Bile-ducts
Duodenum	Appendix	Pancreas.

JAUNDICE WITH ALTERATIONS IN THE FÆCES in diseases of:—

Liver	Bile-ducts	Duodenum.
Gall-bladder	Pancreas	

DISORDERED MICTURITION WITH ALTERED URINE in diseases of:—

Kidneys	Liver and bile-ducts
Ureters	Pancreas
Bladder	Abscesses connected with urinary organs.

ALTERED BLOOD in:—

Some splenic tumours	Tuberculous lesions (opsonins)
Pyogenic abscesses	Cancer of stomach.

PAIN AS THE SOLE SYMPTOM in:—

Colic: Biliary calculus—Renal calculus—Lead colic—Appendicitis—Ovaritis—Dysmenorrhœa.

Displaced viscera: Enteroptosis — Kidney — Spleen — Ovary.

Diseases of spine and nerves: Aneurysm—Caries—Tabes.

Condition of General Abdominal Distension.—

FAT, FLATUS, AND FÆCES give unaltered percussion, and bimanual examination detects no mass in the loins or pelvis.

FLUID, i.e., ASCITES, gives shifting dullness in the flanks, with resonance in the uppermost parts of the abdomen.

LARGE TUMOUR FILLING THE ABDOMEN gives dullness in the central parts, with resonant areas around it.

PHANTOM TUMOUR is in the lower part of the abdomen. No altered percussion. No tumour felt bimanually. Disappears under an anæsthetic.

Chronic Abdominal Affections, *continued*.

Examination of a Local Swelling.—

THE RELATION OF THE SWELLING TO THE PARIETAL WALL.—Movement of the swelling in relation to movements of the parietes, together with the effect of the contraction of the muscles upon the swelling, prove its position upon, in, under, or unconnected with the parietes.

EPIPARIETAL TUMOURS are quite unaffected by muscular contractions, e.g., lipomata or sebaceous cysts.

INTERPARIETAL SWELLINGS are hardened and fixed by muscular contractions, e.g., a fibroma or abscess in the muscles.

SUBPARIETAL SWELLINGS are obscured by muscular contractions, but if fixed to the parietes they always move with them, e.g., an inflammatory or malignant growth attached to the abdominal wall.

VISCERAL SWELLINGS, if unconnected with the parietes, allow the latter to move over them, and parietal muscular contraction tends to obliterate their outline.

HERNIAL SWELLINGS are situated at the linea alba, navel, femoral or inguinal regions, and become more prominent on muscular exertion.

THE POSITION OF THE SWELLING usually corresponds with the normal position of the affected viscus, thus :—

IN THE EPIGASTRIUM.—Gastric, or more rarely hepatic.
RIGHT HYPOCHONDRIUM.—Liver, gall-bladder, right kidney and adrenal.

LEFT HYPOCHONDRIUM.—Spleen, left kidney and adrenal.

UMBILICAL.—Pancreatic, omental, and small intestine.

LUMBAR.—Renal and pararenal. Colon.

RIGHT ILIAC REGION.—Appendix, cæcum. } Psoas, iliac, or
LEFT ILIAC REGION.—Sigmoid colon. } pelvic abscesses.

HYPOGASTRIUM.—Uterus, bladder. Ovarian tumours.

OCCUPYING A LARGE PART OF THE ABDOMEN.—Ovarian, uterine, omental tumours. Hydronephrosis. Malignant and tuberculous disease.

MOVEMENT OF VISCERAL SWELLINGS IN RELATION TO THAT OF THE PARIETES.—

SWELLINGS WHICH MOVE WITH THE PARIETES deep in the abdomen are probably inflammatory or malignant.

MOVEMENT WITH RESPIRATION is most marked in hepatic, splenic, and gastric swellings, less so with renal.

MOBILITY INSIDE THE ABDOMEN.—

HEPATIC AND GASTRIC GROWTHS have little mobility apart from respiratory movements.

A WANDERING SPLEEN can be moved about, with the left hypochondrium as a centre.

GALL-BLADDER SWELLINGS permit sometimes of lateral movements round a centre at the hepatic margin.

RENAL SWELLINGS may be moved up and down, but not at all laterally.

OVARIAN AND UTERINE SWELLINGS can be moved from side to side, but not upwards away from the pelvis.

FIXED TO THE POSTERIOR PARIETES are pancreatic cysts, aneurysm, and deep malignant disease.

OUTLINE OF THE SWELLING.—

A SHARP EDGE characterizes hepatic and most splenic swellings.

A NOTCHED EDGE is only found in the spleen.

A CRAGGY NODULAR MASS is found in malignant growths.

INTENSE HARDNESS suggests actinomycosis or cancer.

A VERY ILL-DEFINED EDGE suggests inflammatory or malignant invasion of the peritoneum.

A GLOBULAR OUTLINE suggests a cyst—renal, ovarian, pancreatic, etc.

PERIODIC CHANGES IN SIZE AND CONSISTENCY.—

PERISTALTIC CONTRACTIONS occur in the stomach or gut above an obstruction.

PAINFUL CONTRACTIONS WITH HARDENING occur in an intussusception, also in a pregnant uterus at labour.

IRREGULAR MOVEMENTS, SEEN OR FELT, occur in the borborygmi of obstruction, and as foetal movements.

DISTENDED BLADDER disappears on catheterization.

PERCUSSION gives valuable information as to : (1) The relation of the alimentary canal to the swelling ; and (2) The presence of free fluid or gas in the abdomen or swelling.

SWELLINGS WHICH ARE RESONANT are gas-containing abscesses, e.g., subphrenic, and rarely parametric abscesses. Also dilated parts of the stomach or gut, and posterior (pancreatic) tumours covered by stomach and bowel.

SWELLINGS WHICH ARE DULL form the majority of visceral tumours and displacements.

KIDNEY SWELLINGS have an area of colic resonance in front of them.

HEPATIC, BILIARY, AND SPLENIC SWELLINGS have the colic resonance below them.

OVARIAN CYSTS are generally dull and surrounded by a resonant area above and at the sides.

ASCITIC COLLECTIONS are resonant centrally, with dull flanks.

Symptom Groups in Abdominal Disease.—

DIGESTIVE.—

ANOREXIA, VOMITING, AND DYSPEPSIA, in disease of the stomach, duodenum, and pancreas.

DYSPEPSIA of an irregular type is often associated with gall-stones or diseased appendix.

CONSTIPATION occurs in any form of obstruction, whether in the stomach or gut. Also in inflammatory conditions, e.g., appendicitis, and in pelvic tumours or displacements pressing on the rectum.

Symptom Groups in Chronic Abdominal Disease, *continued*.

DIARRHŒA ALTERNATING WITH CONSTIPATION characterizes chronic obstruction in the large bowel.

PASSAGE OF BLOOD AND MUCUS is found in malignant disease of the large bowel, and in intussusception, dysentery, and colitis.

JAUNDICE, WITH COLIC AND PALE STOOLS, occurs in hepatic, bile-duct, and pancreatic disease.

DISORDERS OF MICTURITION in renal disease, stone, or displacement; vesical, prostatic, and urethral diseases. Also in disease, displacements, and tumours in the pelvis.

ALTERATIONS IN THE URINE.—Blood, pus, crystals, casts, parasitic ova, mucus, in urinary disease. Bile in hepatic, biliary, and pancreatic disease. Cammidge's crystals in disease of the pancreas.

MENSTRUAL IRREGULARITIES.—

AMENORRHŒA in normal and abnormal pregnancy.

MENORRHAGIA in uterine disease.

IRREGULAR MENSTRUATION in extra-uterine pregnancy.

DYSMENORRHŒA in pelvic inflammatory disease and diseases of the uterine appendages.

LOCOMOTIVE DISORDERS.—

INCREASE OF PAIN caused by walking, in renal and vesical calculus. Diseases of the spine.

ATAXIA, with loss of knee-jerks, etc., in tabes.

VASCULAR DISORDERS.—Arteriosclerosis, high-tension pulse, cardiac hypertrophy, accompany an ANEURYSM.

STEADY LOSS OF WEIGHT is of extreme significance, and generally results from progressive, i.e., malignant, disease of the alimentary canal. The higher the disease the greater and more rapid is this sign. Chronic gastric ulcer and chronic pancreatitis also cause marked emaciation.

SYMPTOMLESS SWELLINGS.—Cysts of the ovary or omentum. Hydatid cysts. Uterine fibroids. Tuberculous abscesses arising from bones (e.g., the ilium) without involving joints. Gummata of the abdominal wall, liver, and spleen.

Special Methods of Examination in Obscure Cases.—

OF THE STOMACH.—Distension with air and fluid, illumination, and shadow of a barium meal.

RADIOGRAPHY shows disease of the spine or pelvic bones, aneurysm. After barium meals or enemata it may show the form and position of the stomach and large intestine. Calculi in the kidney, ureter, or bladder. Certain foreign bodies.

DISTENSION OF THE COLON WITH AIR shows whether a growth is in or outside the colon, and emphasizes the relations of the renal, hepatic, biliary, and splenic tumours.

CYSTOSCOPY, SEGREGATION OF URINE, AND URETERAL CATHETERIZATION, demonstrate obscure lesions of the kidneys, ureters, or bladder, especially tuberculosis.

BLOOD-COUNT (*see* p. 584.)

CHAPTER XLVII.

AFFECTIONS OF THE BLADDER.

ECTOPIA VESICÆ.

Anatomy.—Bladder is only represented by the trigone bearing the ureteral orifices and part of the posterior wall. This part of the bladder is placed in the anterior abdominal wall in the hypogastrium. The penis is rudimentary and shows complete epispadias. The pelvic bones are so ill-developed that the pubes do not meet at the symphysis. The pelvis is very shallow from before backwards. The umbilicus is not recognizable as such.

Symptoms.—Constant dribbling of urine. Excoriation of the skin. Eventual pyelonephritis.

Treatment.—The following are alternative methods, the first being by far the best :—

1. Implantation of the vesical trigone into the rectum, upon which it lies. This does not open the peritoneum.
2. Intraperitoneal implantation of the ureters into the rectum.
3. Plastic operations by which skin flaps are sewn over the bladder, cutaneous surface inwards.
4. The provision of a vulcanite cup to form a urinal.

RUPTURE OF THE BLADDER.

Causes.—Direct blows on the distended bladder. By a wound from a portion of fractured pelvis. Penetrating wounds. Bursting following retention. Bladder is generally ulcerated or sacculated.

Varieties.—(1) Intraperitoneal ; (2) Extraperitoneal.

Intraperitoneal Rupture.—Superior surface involved. Severe shock.

Strangury, i.e., frequent painful attempts at micturition.

SIGNS OF FREE FLUID in the abdomen.

PERITONITIS.

SIGNS.—Catheter withdraws only scanty bloody urine. If lotion is injected into the bladder, less returns than is inserted.

TREATMENT.—Laparotomy. Sponge out the free fluid. Sew up the bladder wound. Drain rectovesical pouch if the urine is septic. Tie in a large catheter.

Extraperitoneal Rupture.—Involves the base or lateral walls. Micturition may not at first be interfered with.

PELVIC CELLULITIS or EXTRAVASATION OF URINE occurs.

DUSKY SWELLING occurs above the pubes and in the perineum.

RAPIDLY FATAL TOXÆMIA if the urine is septic.

TREATMENT.—Free incisions into the swollen areas above pubes and in the perineum. Drain the bladder through a catheter, or by a median urethrotomy.

CYSTITIS.

Causes.—

ACUTE CATARRH.—Cold. Uric acid diathesis. Gout. Irritants, e.g., cantharides.

ACUTE SEPTIC CYSTITIS.—Traumatism—operation, foreign body. Gonorrhœa. Septic wounds or catheters. Direct infection with the colon bacillus through the female urethra. All the causes of chronic cystitis are predisposing causes of acute cystitis.

CHRONIC CYSTITIS.—Stone. Tumour. Large prostate. Stricture. Paralysis from spinal disease. Tuberculosis.

Bacteriology.—

<i>Bacillus coli</i> (alone)	} In acid urine.
<i>B. tuberculosis</i> „	
<i>Gonococcus</i> „	
<i>Streptococcus</i> „	
<i>Bacillus proteus</i>	} Alkaline urine.
<i>Diplococcus ureæ</i>	
<i>Staphylococcus</i>	
<i>Bacillus coli</i> (with the above)	

Symptoms.—

PAIN in hypogastrium and perineum.

VESICAL IRRITABILITY.—Constant desire to micturate. Frequent micturition. Pain after micturition.

URINE.—

IN ACUTE CASES.—May contain blood—Shreds and sloughs of the mucous membrane.

IN SOME CASES.—If infection is purely by an acid-forming organism (*B. coli*, gonococcus, tubercle bacillus), not much change is apparent. The organism can be recognized.

IN MAJORITY OF CASES.—Urine becomes alkaline by a formation of ammonia from the decomposition of urea. Foul smell. Loaded with pus, mucus, epithelium, and phosphates.

GENERAL SYMPTOMS (chiefly in the acute cases).—Toxæmia. Low febrile condition. Exhaustion from want of sleep.

Complications.—Septic infection of the kidneys.

Anatomy.—**ACUTE CHANGES.—**

CATARRH.—Acute inflammation of the mucous membrane.

MUCOUS MEMBRANE is intensely congested. Its vessels become thrombosed. Patches slough and leave ulcers. It may be cast off as a complete slough.

CHRONIC CHANGES.—

MUCOUS MEMBRANE, especially over the trigone.—Thickened and covered with tenacious mucus mixed with phosphatic debris. Superficial layers lost. Congestion, with large dilated vessels. Sacculated and ulcerated.

MUSCULAR WALL.—At first thickened and hypertrophied. Later (if obstruction exists), becomes dilated, thinned, and fasciculated.

URETERS.—Orifices are contracted by muscular spasm.

KIDNEYS.—Hydronephrosis. Pyonephrosis. Pyelonephritis.

Treatment.—

GENERAL.—In acute cases: Rest in bed. Milk diet.

Remove the cause (e.g., stone, stricture).

DRUGS.—

COPIOUS ALKALINE DRINKS.—To diminish irritating uric acid.

BELLADONNA AND HYOSCYAMUS.—For spasm.

ANTISEPTICS.—Hexamine, salol, benzoic acid, to prevent ammoniacal decomposition and to retard the growth of organisms.

DIURETICS.—Citrate of potash, buchu, to diminish the concentration of the urine.

OLEO-RESINS.—Sandalwood oil, cubebs, copaiba, etc. In chronic cases. When there is much mucus, and especially in chronic gonorrhœa.

LOCAL APPLICATIONS (to be avoided in acute cases).—

Irrigation with dilute solutions of permanganate of potash, and boroglyceride.

In very chronic cases: protargol gr. ij ad ʒj, or 0.5 per cent aqueous mercurochrome. The bladder should first be irrigated with warm boric acid solution; ʒj of mercurochrome is then instilled into the empty bladder and the patient instructed to avoid the act of micturition for half an hour.

CYSTOTOMY.—In intractable cases, and as a preliminary to further operations. Perineal route provides the best drainage. Suprapubic route most convenient if a tumour is to be removed.

TUMOURS OF THE BLADDER.**Varieties.—**

BENIGN.—Papilloma—Fibroma and myxoma (rare).

MALIGNANT.—Epithelioma—Columnar-celled carcinoma (secondary to uterine or rectal disease)—Sarcoma (rare).

PAPILLOMA OR BENIGN VILLOUS TUMOUR.

In patients from 14 to 40. Men more often than women.

Anatomy.—Tuft of branching processes. Each consists of central connective tissue and blood-vessels, clothed with transitional squamous epithelium. Submucous and muscular tissues are not involved. Generally at or near the trigone and close to one of the ureteric orifices. Occasionally multiple. May be secondary to villous tumour of the renal pelvis.

Symptoms.—Three stages: (1) Latent, (2) Hæmaturia, (3) Cystitis.

HÆMATURIA.—So-called symptomless hæmaturia, from the absence of other signs or symptoms. Profuse hæmorrhage, more marked at end of micturition. Recurs at long intervals, and lasts for a few days at a time.

VESICAL IRRITABILITY.—Frequent micturition. Pain after micturition from growth being caught in orifice of urethra.

CYSTITIS.—Chronic variety. Passage of quantity of ropy mucus.

HYDRONEPHROSIS (occasional), from a blocking of the ureteric orifice.

Signs.—Sound produces sharp hæmorrhage. Nothing felt by rectum or vagina. Cystoscope shows growth.

Prognosis.—There is often recurrence after operation, with ultimate malignant development.

Treatment.—

CYSTO-DIATHERMY OR FULGURATION.—An electrode from a diathermy apparatus is passed through a cystoscope and applied to the base of the papilloma, which is burnt off when the current is turned on. This method is very suitable for small growths.

OPERATIVE.—Suprapubic cystotomy. Isolate growth with a Fergusson's speculum. Press up its base from the rectum or vagina. Cut away the mucous and submucous tissue from which it grows.

MALIGNANT NEW GROWTHS.

May be primary, or secondary to growth of rectum or uterus.

Primary Growths are:—

1. **MALIGNANT PAPILLOMA.**
2. **INFILTRATING CARCINOMA** (i.e., a carcinoma starting in a previously healthy bladder).
3. **MALIGNANT ULCER.**—Generally secondary to stone.

Symptoms.—Hæmaturia, dysuria, cystitis, pain in hypogastrium and perineum.

In malignant papilloma the hæmaturia precedes the dysuria, but in the other types dysuria precedes the hæmaturia by a considerable interval.

Complications.—Hydronephrosis with pain in the kidney from involvement of the ureter. Pyelonephritis and septicæmia. Retention of urine (rare), from involvement of the urethra.

Signs.—Indurated mass felt in the bladder wall, per rectum or per vaginam. Cystoscope shows a sessile papilloma or an ulcer with thickened margins. Sound may feel a rough area on the bladder wall.

Treatment.—

1. SUPRAPUBIC CYSTOTOMY.—Exposure as in benign growth. Removal of a wide area of bladder wall, including its whole thickness.

If the ureter is involved, the affected part is removed and the proximal end implanted into the bladder in a fresh situation.

2. TOTAL EXTIRPATION OF THE BLADDER.—In extensive growths. Ureters implanted in the rectum or colon; or a double nephrostomy performed.

DIAGNOSIS OF VESICAL GROWTHS.

1. FROM OTHER CONDITIONS RESEMBLING THEM.—

a. RENAL DISEASE.—Stone or new growth. In this: Pain or tumour in the loin. Hæmorrhage is much less profuse. Blood is evenly mixed with the urine. Segregation shows difference between the two sides. Urine remains acid. There is less vesical irritability.

b. STONE IN THE BLADDER.—In this: Pain after micturition, with spasm, is present. Bleeding is slight. Sound feels the stone.

c. TUBERCLE OF THE BLADDER.—In this: Pain and vesical irritability are severe. Bleeding is absent or trivial. Tubercle bacilli in the urine. Cystoscope shows shallow undermined ulcers.

2. OF THE VARIETY OF GROWTH.—

BENIGN GROWTHS are characterized by: Youth of the patient. Profuse recurrent hæmaturia without other symptoms at first. Absence of induration of the bladder wall.

MALIGNANT GROWTHS are characterized by: Patient is over forty-five. Pain and cystitis are early and prominent. Induration is felt in the vesical wall.

TUBERCULOUS DISEASE OF THE BLADDER.

Tuberculosis of the bladder is almost always secondary to tuberculous disease of the kidney, prostate, or testicle.

Pathology.—Starts as a miliary tubercle in the submucous tissue. These caseate and break down, leaving ragged undermined ulcers. Generally situated in or near the trigone.

Tuberculous Disease of the Bladder, *continued*.

Symptoms.—Those of chronic cystitis with hæmaturia. There is great irritability of the viscus.

Prognosis.—Unfavourable.

Treatment.—Deal if possible with primary focus. Bladder lavage. If only a few ulcers, cauterize with galvano-cautery. Injections of tuberculin.

STONE IN THE BLADDER.

Varieties.—

URIC ACID.—Oval or spherical stone. Brown in colour and laminated in texture (*Fig. 149, a*).

Deposits as rhomboidal, 'wheatsheaf', or irregular clumps of crystals.

In acid urine, as result of excessive sweating, too little drinking, excess of nitrogenous food, sedentary habits, febrile condition, gouty diathesis. Much the commonest variety of stone.

AMMONIUM URATE.—Similar to the above, but lighter in colour. Deposits as spiculated globules or as an amorphous deposit.

CALCIUM OXALATE.—Rough, nodulated like a mulberry (*Fig. 149, b*). Very hard. Dark brown or blackish.

Deposits in acid urine, as 'envelope' or dumb-bell-shaped crystals. In nervous and dyspeptic patients.

PHOSPHATIC CALCULUS.—Usually a secondary deposit on a uric acid or oxalate stone or foreign body. Sometimes primary in a saccule of a bladder, deposited by cystitis. Forms a white, soft, friable mass.

Deposits in alkaline urine as triple phosphate (ammonio-magnesium), 'knife-rest' crystals, or hexagonal feathery crystals. Calcium phosphate gives amorphous deposit. The mixed phosphates form a 'fusible calculus'.

CYSTIN.—Yellow, waxy—very rare.

XANTHIN.—Red—very rare.

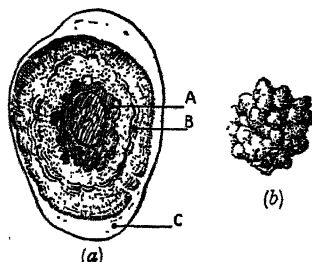


Fig. 149.—Vesical calculi.
(a) Composite stone: A, Nucleus of oxalates; B, Layers of urates; C, Outer covering of phosphates.
(b) Mulberry oxalate calculus.
($\times \frac{1}{2}$.)

Structure (*Fig. 149, a*).—

NUCLEUS at the centre formed by foreign body, renal calculus, or mucus.

BODY.—Concentric layers of crystals held together by mucus.

CRUST.—Most recent deposit. Generally the mixed phosphates.

Occurs when cystitis with alkaline urine has been set up.

NUMBER.—Usually single. Rarely multiple.

Etiology.—

AGE.—Any age, but especially children under ten, men past middle life.

SEX.—Men much more often than women.

SOCIAL CONDITION.—In children it chiefly affects the poor.

CLIMATE, SOIL, etc.—Very common in India and the tropics.

Common in Eastern Counties and where the water is very hard.

LOCAL URINARY CONDITIONS.—Any obstruction predisposes to the deposit of a calculus: especially phimosis in children, and a large prostate in old men.

Gout, lithiasis, or oxaluria usually precede and cause it, often first causing a renal calculus.

Symptoms.—

PREMONITORY.—Renal colic. Incontinence of urine (in children). Passage of gravel, uric acid or oxalates.

PAIN.—In bladder and perineum. Referred to the end of the penis. Worse at the end of micturition.

FREQUENCY OF MICTURITION by day; by day and night when cystitis is present.

VESICAL IRRITABILITY.—Constant micturition, followed by pain and spasm, with sensation of not having emptied the bladder.

HÆMATURIA.—Slight and at the end of micturition.

INFLUENCE OF MOVEMENT.—All symptoms aggravated by movement, and therefore worse by day than night.

SUDDEN CESSATION OF MICTURITION or

ACTUAL RETENTION of urine, from impaction of the stone at orifice or in the urethra.

EFFECTS OF STRAINING and nerve irritation.—Piles or prolapse. Hernia. Priapism.

IN CHILDREN.—Incontinence of urine. Constant pulling at the foreskin.

Signs.—

SOUNDING.—Bladder should be full of urine or lotion. Buttocks raised. Anæsthetic should be given in children. Beak is turned from side to side and then backwards behind a large prostate.

Stone in the Bladder—Signs, continued.

Hard click indicates a stone. It can be heard and felt. Most marked in oxalate or uric acid stones. Least marked in phosphatic stones. May be masked by mucus.

FALLACIES in sounding for a stone :—

Stone may be missed because : It lies deep behind a large prostate, or in a saccule with a narrow mouth, or it is covered with tenacious mucus.

Click or grating is given by conditions other than a stone, viz. : Prostatic calculus. Phosphatic débris on an ulcer or new growth.

RADIOGRAPHY.—All the common varieties of stones are well shown by the X rays.

Diagnosis.—From renal calculus, vesical new growth, vesical tuberculosis (*see* p. 593).

INCONTINENCE IN CHILDREN.—Stone should always be suggested by marked priapism or intractability of the symptoms.

Complications.—

1. **INFECTIVE COMPLICATIONS.**—Cystitis, pyelitis, and pyelonephritis.
2. **OBSTRUCTIVE COMPLICATIONS.**—Hypertrophy and sacculation of bladder. Formation of diverticula. Hydronephrosis.
3. **ULCERATION and CARCINOMA.**

Treatment.—

PRELIMINARY FACTS to be ascertained :—

1. Presence of any urinary obstruction. Size and position of stricture. Presence and character of prostatic growth.
2. Size of the stone. By palpation through the rectum. By grasping with a lithotrite.
3. Nature and consistency of the stone. By examination of the crystals in the urine. By the smooth, or rough, or soft sensation imparted to a sound.
4. Presence of cystitis or kidney disease.

LITHOLAPAXY.—

INDICATIONS.—Stone less than $1\frac{1}{2}$ in. in diameter. Stone must be friable. Absence of stricture or very large prostate. Absence of cystitis or kidney complications.

METHOD.—Buttocks raised. Bladder filled with boracic lotion (at least 6 oz.). Grasp the stone and crush it by lithotrite. Crush all fragments that can be grasped. Wash out all fragments by the evacuator. Use largest evacuating tube possible. Again sound for and treat any residual fragments.

SUPRAPUBIC CYSTOTOMY.—

INDICATIONS.—Large stone ($1\frac{1}{2}$ in. or more). Hard stone which cannot be crushed (especially oxalate stones). Combined with a large prostate. When a stricture exists. When the stone is encysted.

METHOD.—Trendelenburg position. Fill the bladder until it is felt above the pubes. Open immediately above the pubes. After removal of the stone: Drain if cystitis or hæmorrhage exists; otherwise sew up the bladder, but drain the wound.

LATERAL LITHOTOMY.—

INDICATIONS.—A contracted bladder. Severe cystitis. When a stricture (traumatic) of the membranous urethra exists and can be dealt with at the same time.

METHOD.—Pass a sound with a lateral groove into the urethra. Fill the bladder. Place the patient in the lithotomy position. Assistant holds sound in mid-line and against the pubes. Cut from $1\frac{1}{2}$ in. in front of anus to a point midway between anus and left tuber ischi. Deepen this until the knife is in the groove of the sound. Push knife forward into the bladder along the groove. Insert finger and forceps and extract the stone. Leave in a large tube to drain the bladder.

DIVERTICULUM OF THE BLADDER.

Definition.—A sac-like protrusion of some part of the bladder wall.

Varieties.—

1. **CONGENITAL.**—These consist of a protrusion of the muscular coat.
2. **ACQUIRED.**—These consist of a protrusion of mucous membrane only, and may be :—
 - a. **PRESSURE DIVERTICULA.**—These follow the sacculation produced by urinary obstruction—e.g., enlarged prostate, stone.
 - b. **TRACTION DIVERTICULA.**—These are produced by traction from without—e.g., hernia, perivesical inflammation.

Symptoms.—Severe and intractable cystitis from urine stagnating in the diverticulum. May give rise to an encysted calculus, which may ulcerate through the diverticulum, producing extravasation of urine.

Diagnosis.—Made by X rays after filling bladder with barium sulphate or sodium bromide; and by cystoscopy, when the opening of the diverticulum appears as a black aperture in the bladder wall.

Treatment.—Excision of the diverticulum, or suspension of the apex of the diverticulum in such a manner that dependent drainage is obtained.

INCONTINENCE OF URINE.

Definition.—Involuntary micturition due to abnormal detrusor action or defective sphincter action.

Incontinence of Urine, *continued*.

1. **Active Incontinence.**—Abnormal detrusor action, common in children, especially boys. Generally at night—'nocturnal incontinence'.

CAUSES.—Reflex stimulation of abnormally excitable vesical centre. For example, by: Slight vesical distension—Rectal parasites or polypus—Phimosis—Uric acid gravel—Emotions.

TREATMENT.—Remove any abnormal cause of irritation.

Wake child to pass water before bladder is too full.

Bland diet: No meat in evenings.

Drugs: Iron and arsenic as tonics. Belladonna and bromides as sedatives.

Instruments (in obstinate cases only): Passage of a metal sound. Gentle faradization through this.

2. **Passive Incontinence.**—Defective sphincter action.

- a. **PARALYTIC.**—From injury of vesical centre in the cord. Sphincter is paralysed and remains relaxed. Urine dribbles out from the ureters to the urethra. Bladder remains empty and contracted.

- b. **MECHANICAL.**—When a stone or growth holds open the neck of the bladder (very rare). Over-distension of female urethra.

TREATMENT OF PASSIVE INCONTINENCE.—That of its cause. Also an attempt to prevent cystitis by aseptic precautions at the external meatus.

3. **False Incontinence.**—Distension with overflow. Bladder is greatly distended, and the urine constantly dribbles away.

- a. **OBSTRUCTION** to the outflow of urine. Enlarged prostate. Stricture of the urethra.

- b. **SPINAL CORD INJURY.**

TREATMENT OF FALSE INCONTINENCE.—That of the cause, with aseptic precautions.

RETENTION OF URINE.

Causes.—

1. **OBSTRUCTION TO THE OUTFLOW.**—

IN PENIS.—Phimosis—Rings, bands round penis—Malignant growth (very rarely causes obstruction).

IN URETHRA.—Stricture—Congestion with spasm—Impacted stone—Rupture.

IN PROSTATE.—Hypertrophy—New growth—Inflammation.

IN BLADDER.—New growth—Stone (rarely cause retention).

OUTSIDE NECK OF THE BLADDER.—Pressure of tumours, e.g., uterine fibroids—Retroverted gravid uterus.

2. **NERVOUS.**—Diseases of the spinal cord, especially tabes or myelitis. Injury of brain or spinal cord. Injury of the reflex nerve mechanism, e.g., by operations on the rectum or genital organs. Hysteria.

3. ATONY of the bladder produced by: Over-distension—acute or chronic. Cystitis (rare). In old age (probably associated with prostatic enlargement).

Symptoms.—Bladder presents as a tense hypogastric swelling. Pain of a constant character in abdomen and perineum (this is absent in paralytic cases).

Results.—

CLINICAL.—(1) Rupture of the bladder; or (2) Rupture of the urethra; or (3) Distension with overflow—false incontinence.

PATHOLOGICAL.—

ON THE BLADDER.—In acute cases: Dilatation and atony. In chronic cases: Hypertrophy, followed by dilatation and sacculation.

ON THE KIDNEYS.—Hydronephrosis or pyonephrosis. Pyelonephritis.

Diagnosis.—

SUPPRESSION OF URINE.—In this: The bladder is empty and contracted. Follows some severe shock, or operation, or nephritis. Scanty urine is of high specific gravity and albuminous.

CALCULOUS ANURIA.—History of lumbar pain and colic. Bladder is empty. Pain is absent or exists only in the loins.

RUPTURED BLADDER.—Follows an injury. Bladder is empty or contains bloody urine. More lotion can be put in than got out of the bladder.

Treatment.—

1. WHEN CONGESTIVE SPASM IS THE CAUSE: First try hot baths, with morphia and belladonna suppositories. Then pass a soft catheter.
2. WHEN DEFINITE OBSTRUCTION EXISTS: Pass large soft catheter first; if this fails, then small or filiform catheters.
3. WHEN THE PROSTATE IS ENLARGED: First try large soft catheter, then catheter coudé, then metal prostatic catheter.
4. WHEN NO KIND OF CATHETER CAN BE PASSED :—
 - Suprapubic Drainage.*—Pass a de Pezzer's tube through the cannula and leave it in the bladder.
 - Suprapubic Cystotomy.*—When a large prostate or vesical growth can be dealt with later, or calculus at the same time.
 - Perineal Cystotomy.*—When a urethral stricture exists which can be treated at the same time.
 - In acute retention of many hours' standing, and in chronic retention with cystitis,* it is better to relieve the retention first by a catheter or aspiration, and do a radical operation later when the patient and the bladder are in better condition.

CHAPTER XLVIII.

DISEASES OF THE PROSTATE.

INFLAMMATION.

Varieties.—Acute prostatitis, acute abscess. Chronic prostatitis. Tuberculous prostatitis.

Acute Prostatitis.—

CAUSES.—Gonorrhœa. Sepsis secondary to instrumentation—Stricture—Cystitis.

ANATOMY.—Inflammatory swelling of the whole organ. Ducts and follicles plugged by mucus and bacteria. Abscess forms: (a) In one of the follicles; or (b) In the parenchyma spreading through the capsule.

SYMPTOMS.—Burning pain in the perineum, worse on sitting. Frequent painful micturition. Retention of urine from spasm and congestion. Constitutional symptoms of fever. Constipation. Pain during and after defæcation.

SIGNS.—Passage of prostatic shreds or pus in urine. Inflamed prostate felt per rectum. Brawny swelling in the perineum. When suppuration occurs under or outside the capsule, fluctuation felt by rectum or in the perineum.

COMPLICATIONS.—Abscess may burst into: Urethra—Bladder—Rectum—Perineum. Rectal or perineal fistula may result. Cystitis and septic disease of the kidneys.

TREATMENT.—Rest and milk diet. Hot hip-baths. Fomentations to perineum. Hot enemata. Morphia and belladonna suppositories. For retention: Soft catheter. For suppuration: Median perineal incision.

Chronic Prostatitis.—

CAUSES.—Posterior urethritis (gonorrhœa). Cystitis. Stricture.

SYMPTOMS.—Frequent micturition. Slight pain after micturition. Sense of weight in the perineum. Discharge of albuminous material after micturition, especially the first thing in the morning. Passage of mucous casts of the prostatic glands. Rarely a chronic abscess forms.

SIGNS.—Tender enlargement felt per rectum.

COMPLICATION.—Formation of prostatic calculi.

TREATMENT.—Bland diet. Absence of sexual excitement. Copious fluids, with diuretics. Irrigation of the prostatic urethra with protargol lotion, gr. j ad ʒj. Passage of large bougies. Belladonna suppositories.

Tuberculous Prostatitis—Usually secondary to tuberculous disease of testis or vesiculæ seminales. Rarely primary.

ANATOMY.—Caseous deposits in the prostate. Chronic abscesses. Ragged ulceration, generally the result of septic infection.

SYMPTOMS.—Those of chronic prostatitis. Pyuria, with urine which is acid at first and may contain tubercle bacilli. Rectal examination reveals a tender irregular enlargement of the prostate.

COMPLICATIONS.—In all except the mild primary cases it spreads to the bladder and kidneys.

TREATMENT.—Generally only constitutional. Bland diet with copious fluids. Morphia and belladonna suppositories for pain. Rarely in primary cases, removal through the perineum.

Prostatic Calculi result from deposit of lime salts in the follicles.

In cases of chronic prostatitis. Consist of carbonate of lime.

Usually multiple. Collect in enlarged prostatic pouches.

SYMPTOMS.—Irritability of the bladder. Difficulty in micturition.

SIGNS.—Those of chronic prostatitis. Felt by a sound just before entering the bladder.

TREATMENT.—Removal through a median perineal incision.

ENLARGEMENT OF THE PROSTATE.

Anatomy of the Normal Gland.—Shaped like a pyramid, with four triangular surfaces. Normally measures a little over an inch transversely, about one inch in other diameters.

SURFACES.—

SUPERIOR SURFACE is in the cavity of the bladder; is pierced by the internal meatus; is covered by vesical mucous membrane.

POSTERIOR SURFACE is related to vesiculæ seminales. Separated from rectum by fascia and cellular tissue, and is covered by rectovesical fascia.

LATERAL SURFACES.—Lie on the origin of the levatores ani from the pubes. Are covered by visceral layer of pelvic fascia. This is connected to the pubis in front as the puboprostatic ligament.

APEX.—Situation on the junction between the lateral surfaces. Is pierced by the urethra. Rests on that part of the pelvic fascia which forms the deep layer of the triangular ligament.

CONNECTIONS.—

BLADDER.—The mucous membrane is continued over its superior surface into the urethra. The muscular wall is continued into its posterior and lateral surfaces.

URETHRA traverses the gland from its superior surface to its apex.

EJACULATORY DUCTS.—Traverse its substance from its posterior surface to join the urethra.

Enlargement of the Prostate—Anatomy of Normal Gland, *continued*.

SURROUNDINGS.—The gland with its fibromuscular capsule is surrounded by:—

1. The neck of the bladder, which is structurally continuous with the fibromuscular capsule.
2. Cellular tissue containing the prostatic plexus of veins.
3. A sheath of fascia: (a) Deep layer of triangular ligament; (b) Visceral layer of pelvic fascia at the sides; (c) Rectovesical fascia behind. (These are all parts of the same fascia, forming a continuous 'SHEATH' for the prostate.)

STRUCTURE.—Consists of two kinds of tissue: (1) Mass of unstripped muscle and fibrous tissue; (2) Glandular tissue embedded in (1).

CAPSULE consists of the peripheral parts of the fibromuscular tissue arranged in a laminated manner. This dips down as a median raphe, and joins the anterior and posterior walls of the urethra. There is no distinct demarcation between the capsule and the rest of the gland in normal conditions.

LOBES.—Two primary lateral lobes lie on each side of the median raphe. A central, median, or third lobe is that part of the gland superior and posterior to the internal urethral meatus; it is divided from the lateral lobes by the ejaculatory ducts.

DUCTS.—The glands of the lateral lobes open by ten to fifteen ducts into the groove on the floor of the urethra at the side of the crista urethræ. The glands of the middle lobe open into a recess—the sinus pularis—which opens on the summit of the crista urethræ. The ejaculatory ducts open on either side of the orifice of the sinus pularis. The median lobe of the prostate is the uterus masculinus.

Etiology.—Common after fifty. May be caused by prostatitis, urethritis, or lithiasis, or any condition of chronic vesical irritability. Usually is merely a senile change.

Morbid Anatomy (*Fig. 150*).—

PROSTATIC CHANGES.—

SHAPE AND SIZE.—At first it retains its shape, then it becomes lobulated and irregular. The lateral lobes enlarge towards the rectum.

The median lobe and the whole of the superior surface grow up into the bladder.

A median constriction marks the attachment of the neck of the bladder, and separates the intravesical from the extravascular parts of the gland.

STRUCTURE.—The enlarged gland consists of either: (1) Excess of fibrous tissue: usual in the smallest specimens which cause symptoms. (2) Overgrowth of all the normal tissues: usual in the smooth, medium-sized specimens. (3) Fibromyomatous tumours or fibroids: may form large masses.

(4) Fibro-adenomata, i.e., overgrowth of the glandular tissue : constitute the bulk of the largest specimens. (5) A well-marked laminated capsule consisting of layers of fibro-muscular tissue surrounds the rest of the mass, and is continuous with the muscular walls of the bladder.

CONSISTENCY.—Hard when chiefly fibrous tissue. Soft when formed by adenomata.

CHANGES IN THE URETHRA.—Elongated from one to several inches. Curved with the convexity backwards. Tortuous from the pressure of enlarged lobules. Internal meatus may be distorted or blocked by the growth of the median lobe, or rarely held open by the same.

CHANGES IN THE BLADDER AND KIDNEYS.—The bladder becomes first hypertrophied and then dilated, the muscular fasciculi being separated, and the mucous membrane pouched between the fasciculi. Cystitis occurs sooner or later. Hydro-nephrosis, pyonephrosis, or pyelonephritis may result from chronic retention and cystitis.

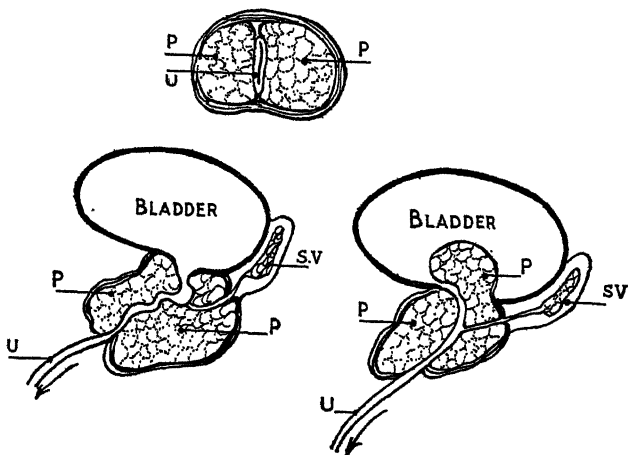


Fig. 150.—Diagram of prostatic enlargement. Upper figure is a transverse section of prostate, showing urethra (U) compressed by the lateral lobes of the prostate (P). The two lower figures are antero-posterior sections. That on the left shows an elongated and tortuous urethra; that on the right an elongated and curved urethra, obstructed by an overhanging middle lobe. S.V., Seminal vesicles.

Enlargement of the Prostate, *continued*.

Symptoms.—There are usually four stages, though the earlier ones may not be noticed or complained of, viz. :—

1. **DIFFICULTY IN MICTURITION.**—A long time is taken in starting the stream. The stream is of good bulk but slow, and projected with little or no force. Straining often checks the stream.
2. **FREQUENT MICTURITION.**—Due at first to congestion and irritability of the neck of the bladder, later to retention. Worse at night, or most noticeable then.
3. **RETENTION OF URINE.**—The bladder cannot empty itself when the obstruction increases or when the bladder becomes weak. Hence some residual urine is left after each act. This varies from one to ten ounces, and constitutes the measure of the inefficiency of the bladder. Acute retention may be the first sign, or more commonly supervenes on chronic retention when micturition has been delayed so long that the bladder becomes atonic, or results from congestive spasm caused by cold or alcoholic excess. False incontinence (retention with overflow) may supervene in any neglected case.
4. **CHRONIC CYSTITIS.**—Infection is usually by instruments. May arise by auto-infection. Urine becomes ammoniacal and loaded with phosphates, pus, and mucus.

Physical Signs.—

SIGNS OF RETENTION OF URINE in the absence of stricture or paralysis. Bladder felt above the pubes (rare in early cases). Presence of residual urine after micturition.

RECTAL EXAMINATION.—Gland is felt on the anterior rectal wall, about $2\frac{1}{2}$ in. from the anus. It feels large or lobulated. It may feel practically normal.

URETHRAL EXAMINATION.—The prostatic urethra is elongated—judged from the distance the catheter must be passed from the pubic arch till the bladder is entered. Normally this is about $1\frac{1}{2}$ in.; in prostatic cases it is anything up to 4 in.

A long curved catheter or a coudé passes most easily.

CYSTOSCOPE.—The intravesical enlargement may be seen with difficulty.

Treatment.—

1. **DIET AND DRUGS.**—For mild cases without any residual urine.

DIET.—Meat and rich food to be taken very sparingly. Plenty of milk, alkaline waters, and diluents. Avoid alcohol.

REGULATION OF THE BLADDER.—Never postpone micturition after the desire occurs.

DRUGS.—Alkalis, e.g., bicarbonate and citrate of potash. Sedatives, e.g., hyoscyamus or belladonna. Antiseptics: hexamine, salol, to prevent or minimize cystitis.

2. CATHETER TREATMENT.—For cases in which retention occurs, either acutely or chronically, shown by the existence of residual urine.

CHOICE OF INSTRUMENT.—(a) No. 12 rubber catheter; (b) Coudé or bicoudé; (c) Metal catheter with long prostatic curve. A rubber or metal instrument is better for regular use because it can be boiled.

METHOD.—Passed once a day—preferably at night. Antiseptic precautions for the meatus and catheter. Efficient lubrication.

CONTRA-INDICATIONS.—Existence of a tight urethral stricture. Great pain on catheterization, due to nervousness or irritability of the bladder. Bleeding on catheterization. Patients who cannot carry out the necessary antiseptic precautions. Patients who cannot pass the catheter themselves. Occurrence of rigors and fever (catheter fever). Cystitis (if this can be cured by irrigation of the bladder, the catheter may be resumed, but cystitis quickly recurs).

3. RADICAL OPERATIVE TREATMENT—PROSTATECTOMY.

INDICATIONS.—Cases where catheter life is contra-indicated (*see above*). Comparatively young patients (fifty to sixty-five). When the prostate is rapidly growing (adenomata). When cystitis has occurred. When the kidneys are proved to be efficient as judged by the blood urea and the urea concentration tests (*see p. 576-578*).

a. SUPRAPUBIC OPERATION (routine method).—Fill the bladder with lotion. Open above the pubes. Incise the mucous membrane over the prostate. Press up the prostate by left fingers in the rectum. Insert the index finger between the bladder wall and the prostate through the opening in the mucous membrane. Sweep round the prostate between the layers of the capsule. Tear through the urethra as it enters the deep layer of the triangular ligament. Remove the prostate. Irrigate the bladder with hot water. Tie in a large drainage tube. Sew the bladder and parietes round the tube. Arrange some suction or siphonage apparatus, e.g., Cathcart's irrigator or Irving's dressing. Patient should pass water by penis in seven to ten days. Lessen the drainage gradually.

b. TWO-STAGE OPERATION.—Should always be done in the following conditions: Retention severe enough to demand operative relief; cystitis; calculus; renal efficiency on the border line of safety. The bladder is drained by a simple suprapubic cystotomy or by the insertion of a de Pezzer catheter through an abdominal stab incision. After an interval of ten days to one month the prostate is removed, provided that the renal function has improved to safety point.

Enlargement of the Prostate—Operative Treatment, continued.

Disadvantages of the above Operations.—The whole of the prostatic urethra is removed. The ejaculatory ducts are necessarily, and the vesiculæ seminales occasionally, removed.

Results.—(a) Complete recovery, with normal micturition, in about 70 to 80 per cent. (b) Death in about 20 per cent of the cases from : Shock and hæmorrhage—Mania—Septic infection, especially through the kidneys—Senile asthenia—Uræmia. (c) Recovery with permanent suprapubic fistula. (d) Recovery with an atonic bladder which requires occasional catheterization.

- c. **OPEN SUPRAPUBIC OR THOMSON-WALKER OPERATION.**—A 4-in. incision is made and the bladder freely opened so that the hand may be inserted. The prostate is then enucleated without inserting the left finger into the rectum. The patient is now placed in the full Trendelenburg position and a self-retaining retractor inserted into the bladder. Any loose tags of prostatic tissue are then removed under direct vision and the bleeding points under-run and tied. The mucous membrane at the orifice of the cavity is trimmed, and a wedge is cut out of the prominent semilunar ledge forming the posterior lip of the opening.

Advantages.—There is less risk of infection because there has been no trauma to the rectum. The risk of hæmorrhage is less, and owing to cutting away the semilunar ledge there is very little possibility of post-operative fibrous narrowing of the vesico-prostatic opening.

d. **PERINEAL PROSTATECTOMY.**—

Indications.—Slight enlargement. Severe cystitis. Contracted bladder. Feeble constitution.

Method.—Crescentic incision in front of the rectum. Deepened through the triangular ligament and the compressor urethræ. Cut through the deep layer of the triangular ligament, i.e., the visceral layer of pelvic fascia. Cut the urethra through as high as possible. Shell out the prostate through an incision into its capsule. Drain through the incision.

Advantages.—Less shock than the suprapubic method. The urethra can be more deliberately and accurately divided. Better drainage is afforded.

Disadvantages.—Injury to the compressor urethræ and to the pelvic fascia. Greater liability to a permanent fistula.

4. **OTHER OPERATIVE PROCEDURES.**—

Removal of adenomata from within the fibromuscular capsule of the prostate.

Removal of projecting masses through the urethra by diathermy. Castration or double vasectomy to induce prostatic atrophy.

MALIGNANT DISEASE OF THE PROSTATE.

This is always a round-celled carcinoma. Its ordinary symptoms and signs are indistinguishable from those of benign prostatic enlargement, and in its early stages it is seldom recognized as malignant before operation. The following points may indicate its nature:—

1. The rapidity of development of the symptoms of urinary obstruction.
2. The early occurrence of hæmorrhage, both spontaneous and after instrumentation.
3. Pain and cystitis will be earlier and more conspicuous than in simple enlargement.
4. By the rectum the growth feels large, hard, and nodular, and later the rectal walls become fixed to it.
5. The mucous membrane is fixed and not freely movable over the prostate.
6. The median raphe is soon lost.

TREATMENT.—If its nature is not recognized before suprapubic enucleation is performed, the operation may prove of exceptional difficulty, the growth tearing instead of shelling out. Bleeding will be unusually profuse, and recurrence early and rapid.

PERINEAL PROSTATECTOMY should be performed if malignancy is recognized before operation. After exposure of the gland and division of the membranous urethra, the prostate is removed, together with its proper capsule, from inside its sheath of pelvic fascia. The bladder walls are cut at their junction with the prostate, and the latter is removed. The bladder is sewn to the urethra over a rubber catheter.

RADIUM.—A suprapubic cystotomy is performed, and radon seeds or radium needles are buried in the prostate.

CHAPTER XLIX.

AFFECTIONS OF THE URETHRA.

TRAUMATIC RUPTURE.

Causes.—Falling astride. Blows on the perineum. Fracture of the pelvis.

Situation.—Membranous urethra, usually as it passes through the (superficial) triangular ligament.

Extent.—Partial, through the floor; or entire, through the whole circumference.

Symptoms.—Pain. Retention of urine.

Signs.—Ecchymosis and swelling of perineum, scrotum, and penis. Extravasation of urine if micturition is attempted. Bleeding from the urethra.

Result.—Fibrous stricture of a dense resilient character, or death from extravasation.

Treatment.—*In all cases, immediate suprapubic cystotomy.*

IF NO PERINEAL BLEEDING OR SWELLING OCCURS: Adopt no local treatment. Rest in bed.

IF PERINEAL SWELLING OCCURS: Open the urethra at once. Find the ends of the torn portion. Sew together over a soft catheter. Leave catheter in for one week.

IF EXTRAVASATION OF URINE HAS OCCURRED: Open the urethra in the perineum; pass a tube into the bladder. Make multiple incisions over the swollen parts. Immediate union of the ends of the urethra over the catheter in recent cases.

STRICTURE OF THE URETHRA.

Anatomy of Normal Urethra.—

1. PROSTATIC URETHRA.—Widest and most dilatable part of urethra.

LENGTH.—One inch or more.

DIAMETER.—Large, admitting No. 20 sound. About $\frac{1}{2}$ in.

SHAPE.—On section, horseshoe-shaped with convexity (verumontanum) forwards.

STRUCTURE.—Median ridge—the crista urethræ—runs along the floor. On this opens mesially the sinus pularis, and at the sides the ejaculatory ducts.

Lateral grooves into which the ducts of the lateral lobes of the prostate open.

DIRECTION.—Vertical.

STRICTURE.—Very rare; only as result of trauma or operation such as prostatectomy.

2. MEMBRANOUS URETHRA.—

LENGTH.—Half an inch.

DIAMETER.—About $\frac{1}{4}$ in. Admits a No. 12 sound with some tension. Narrows in its passage through the superficial triangular ligament.

POSITION.—Runs from the prostatic sheath, i.e., the deep triangular ligament, to the superficial triangular ligament.

SURROUNDED by the compressor urethræ. Cowper's glands lie on each side.

DIRECTION.—Downward and forward.

STRICTURE.—Always traumatic.

3. SPONGY URETHRA.—

LENGTH.—Six inches or more.

DIAMETER.— $\frac{1}{4}$ in. No. 12 sound fills it without tension. Narrowest point of whole canal is at the external meatus.

SHAPE.—Horizontal slit, except at meatus, where it is a vertical slit.

STRUCTURE.—

Mucous membrane is lined with columnar cells. Lacunæ open into it. The lacuna magna is larger than the rest, and opens into the upper wall far back near the beginning. Minute simple glands—glands of Littre—also open into it.

Very vascular submucous layer underlies the mucous membrane.

Unstriped muscle is round this, and

Erectile tissue of corpus spongiosum surrounds the whole.

DIRECTION.—First horizontal. Then upwards and forwards. Then in the line of the penis.

STRICTURE.—Inflammatory.

Varieties of Stricture.—(1) SPASMODIC AND CONGESTIVE; (2) INFLAMMATORY; (3) TRAUMATIC.

Spasmodic and Congestive Strictures.—

SITUATION.—In the bulbous urethra.

CAUSES.—Acute urethritis. Slight blows on the perineum. Cold and wet. Alcoholic or sexual excess, especially when some organic stricture co-exists. Injury from passage of instruments. Operations on the rectum, perineum, or testis.

TREATMENT.—Hot bath. Hot enema. Morphia and belladonna suppository. If retention is unrelieved, large soft catheter.

Inflammatory Strictures.—

AGE.—Commonest in patients from twenty-five to fifty.

CAUSES.—Gonorrhœa—by far the commonest. Ulcer caused by a foreign body. Urethral chancre—very rare.

PATHOLOGY.—The mucous membrane is subject to a suppurative catarrh. At certain spots this penetrates deeply, probably where glands or lacunæ are involved. The mucous membrane here is

Inflammatory Strictures—Pathology, *continued*.

destroyed and an ulcer produced. The organisms and inflammatory process are thus admitted to the vascular submucous tissue. In the submucous tissue a chronic plastic inflammation occurs, producing a round-celled infiltration. This in time is converted into scar tissue, the contraction of which causes the stricture.

THE STRICTURE.—Mucous membrane is lost by ulceration. Mass of cicatricial fibrous tissue occupies the rest of the urethral wall and penetrates into the spongy body to a greater or less extent. Malignant disease is a rare complication which may be superadded to stricture. It is usually a transitional-celled carcinoma.

URETHRA ABOVE THE STRICTURE.—Dilated. Septic inflammation, with the loss of the superficial layers of the mucous membrane. Ulcerated in old neglected cases. Orifices of glands and lacunæ dilated. Deep layers of the urethra thickened and indurated.

BLADDER.—Well-marked hypertrophy. Dilatation with sacculation occurs much later and less frequently than in prostatic obstruction, owing to youth of the patient. Inflammatory changes occur, with cystitis.

KIDNEYS AND URETERS.—Undergo dilatation. Hydronephrosis. Pyonephrosis and pyelonephritis with advent of sepsis.

POSITION.—Just in front of the triangular ligament is much the commonest place. May be anywhere in the spongy urethra.

NUMBER.—One usually, but multiple occasionally.

VARIETIES.—

ANNULAR.—Whole circumference involved, but for only a short length.

RIBBON.—As in last, but for a considerable length of the tube.

BRIDLED.—Only a part of the circumference affected.

RESILIENT.—A stricture which contracts rapidly after dilating.

IMPASSABLE.—An instrument cannot be passed.

IMPERMEABLE.—Urine cannot pass.

SYMPTOMS.—

DIFFICULT MICTURITION.—Stream can be started without delay after straining. Takes a long time to complete the act. Stream is poor compared with the force required.

DRIBBLING AFTER MICTURITION.—The dilated urethra between the bladder and stricture slowly empties itself and trickles on to patient's clothes.

IRRITABILITY OF THE BLADDER.—Frequent micturition.

RETENTION OF URINE.—Acute, ending in extravasation; or chronic, with false incontinence.

URETHRAL DISCHARGE of a mucopurulent, thin character.

URINE AT FIRST shreddy, with small casts from the mucous glands and urethra, passed with the first portion of urine.

URINE LATER, mucopurulent and ammoniacal from the changes of cystitis.

CYSTITIS supervenes sooner or later in untreated cases.

PHYSICAL SIGNS.—Those of retention of urine. Obstruction to passage of a urethral sound or catheter. Induration round the stricture felt externally, especially in bad strictures in the bulb.

METHOD OF PASSING INSTRUMENTS.—

PRELIMINARY.—Patient lying on his back with head and knees raised. Cleanse the glans and meatus. Syringe the urethra with dilute antiseptic. Inject one drachm of carbolic oil.

TO ASCERTAIN THE EXISTENCE OF AN ORGANIC STRICTURE.—Pass a No. 9 Lister's bougie. If this passes easily, the stricture does not exist or is merely spasmodic.

TO FIND THE POSITION OF THE STRICTURE.—Note the point at which the point of the bougie is arrested. Note the distance from the meatus.

TO FIND THE SIZE OF THE STRICTURE.—Pass small filiform or olive-headed bougies. Note the size of the one which is firmly grasped by the stricture.

TO FIND THE LENGTH OF THE STRICTURE.—Pass acorn-headed bougie through the stricture. Withdraw it and note the distance it is withdrawn from the moment it engages the stricture until it is released.

Use soft flexible bougies à boule whenever possible. Never use any force in trying to pass a stricture.

DIRECTION.—Pass the instrument with its handle parallel to Poupart's ligament. Then rotate the penis into mid-line. Raise the handle at right angles to the body, and allow the point to slip round the pubic arch.

POINTS WHERE SMALL INSTRUMENTS MAY BE CAUGHT.—

In one of the lacunæ, especially the lacuna magna on roof of the urethra. Keep point on the floor of the urethra as far as perineum.

At the triangular ligament. Keep the point on the roof of the urethra as it passes round the pubes.

In the sinus pularis in floor of prostatic urethra. Keep the point on the roof of the prostatic urethra.

INJURIES AND OTHER EFFECTS WHICH MAY RESULT FROM PASSAGE OF INSTRUMENTS.—

HÆMORRHAGE indicates abrasion and laceration.

FALSE PASSAGES.—Sharp point of a metal instrument may pierce the urethral wall and re-enter the urethra or bladder, or produce a sinus. Signs: A sudden 'give', hæmorrhage, and pain. Results: Increased symptoms of retention—Peri-urethral abscess—Perineal fistula.

CYSTITIS or EPIDIDYMITIS from sepsis.

Inflammatory Strictures—Passage of Instruments—Effects, *continued*.

URINARY FEVER.—Sapraemia due to absorption of toxins through abrasion. Septicæmia due to invasion of the kidneys by micro-organisms.

SHOCK may occur in nervous patients.

SUPPRESSION OF URINE is rare, and supervenes on some previous disease of the kidneys.

Traumatic Stricture of the Urethra.—

CAUSE.—Follows rupture of the membranous urethra.

POSITION.—Usually at the (superficial) triangular ligament.

CHARACTER.—Dense mass of scar-like cartilage extending on both sides of the triangular ligament. Sound grates upon its surface. It rapidly contracts, even if it can be dilated.

RESULTS.—Acute or chronic retention. Dilatation and ulceration of the urethra behind the stricture. Perineal abscess or fistula. Extravasation of urine.

Treatment of Organic Strictures.—

I. OF PASSABLE STRICTURES.—

1. GRADUAL DILATATION.—Used for the majority of cases. Use Lister's bougies. Pass two or three sizes once a week. Continue until a No. 9 to 12 passes easily.

2. CONTINUOUS DILATATION.—Useful in a small stricture with severe retention. Tie in a small instrument for forty-eight hours. Then a larger size for the same time. Later practise gradual dilatation.

3. EXCISION OF THE STRICTURE.—Suitable for cases in which catheterization is badly borne. Cases which rapidly relapse after dilatation. Very dense strictures. Stricture of one inch or less in length.

Method.—Pass a sound or Syme's staff down to or through the stricture. Expose the urethra and split it through the stricture. Cut out the stenosed part. Sew together the two healthy ends like a ribbon, allowing longitudinal incision to close spontaneously. Drain the external wound. Tie in a soft catheter.

4. INTERNAL URETHROTOMY.—Very inferior to excision. Used in the same class of cases. Limited to those which admit a No. 4 bougie.

Method.—Civiale's urethrotome passed through the stricture. The knife is unsheathed. The instrument is withdrawn. The knife is sheathed after cutting through the stricture. In the bulbous urethra cut towards the roof. In the penile urethra cut towards the floor. Tie in a No. 10 catheter for some days.

5. EXTERNAL URETHROTOMY.—Same class of cases as excision. The stricture must admit a No. 2 bougie.

Method.—Pass a Syme's staff with the small end through the stricture. Cut through the stricture from behind forwards. Tie a catheter in the bladder. Leave the perineal wound open.

II. OF IMPASSABLE STRICTURES.—

1. WITHOUT RETENTION.—

WHEELHOUSE'S OPERATION.—Pass a Wheelhouse's staff. Open the urethra upon the groove. Retract the opening by the hook on the staff. Cut open the stricture from before backwards. Tie in catheter.

EXCISION OF THE STRICTURE should always be attempted as a final stage where this is practicable.

2. WITH RETENTION.—

COCK'S OPERATION.—Median perineal incision. Stab incision into the prostatic urethra, using a finger in the rectum as guide.

URETHROTOMY ON A MORE DELIBERATE PLAN IS MUCH BETTER.—Begin by a suprapubic cystotomy. Pass sound from bladder to stricture. Cut down upon sound in the perineum. An excision may often be done later, when the patient and the local conditions are more healthy.

Local Complications of Stricture.—

1. PERINEAL ABSCESS.—Caused by ulceration of the urethra behind the stricture. Septic urine leaks into peri-urethral structures.

TREATMENT.—Open freely externally. Find the opening into the urethra. Pass a full-sized catheter into the bladder. Treat the stricture later.

2. PERINEAL FISTULÆ.—The result of an untreated abscess. Generally multiple, opening on to the perineum, buttocks, or scrotum. Lead into tortuous sinuses buried in dense cicatricial tissue.

TREATMENT.—Lay all the sinuses freely open. Open the urethra above the stricture. Tie in a catheter from bladder to perineum. Treat the stricture later or at the same time.

3. EXTRAVASATION OF URINE.

EXTRAVASATION OF URINE.

Causes.—

RUPTURE OF THE BLADDER—extraperitoneal.

RUPTURE OF THE URETHRA BEHIND A STRICTURE.

1. DIRECT RUPTURE following acute retention.
2. RUPTURE OF AN ULCERATED URETHRA following chronic retention.

RUPTURE OF A PERI-URETHRAL ABSCESS into the subcutaneous tissues.

Extravasation of Urine—Causes, *continued*.

INJURIES TO THE URETHRA by instruments which have forced false passages round the stricture and re-entered the urethra above the stricture.

TRAUMATIC RUPTURE OF THE URETHRA.

Anatomy.—

MEMBRANOUS URETHRA is ruptured usually at or near the superficial triangular ligament.

URINE ESCAPES through the triangular ligament.

Is **DIRECTED BY COLLES'S FASCIA**: Forwards to the scrotum and penis; upwards to the anterior abdominal wall.

Is **BOUNDED BY ATTACHMENT OF THE SUPERFICIAL FASCIA** to inner end of Poupart's ligament, and thence horizontally across the thigh to the fascia lata.

Symptoms.—Sensation of rupture when straining to relieve retention. Feeling of relief of the retention without passing urine. Rapidly fatal sapræmia or septicæmia.

Physical Signs.—Rapidly increasing boggy swelling of the perineum, external genitals, anterior abdominal wall. Parts becoming dusky and then gangrenous. An emphysematous crackling is caused by the gas formed in the subcutaneous tissues. Extensive sloughing of the skin occurs if the patient recovers.

Treatment.—Early free incisions into all the affected parts. Suprapubic cystotomy with bladder drainage and irrigation. Hot hip-baths, with fomentations over all the incisions.

CHAPTER L.

DISEASES OF THE MALE GENITAL ORGANS.

DISEASES OF THE PENIS.

Malformation.—

PHIMOSIS and PARAPHIMOSIS (*see below*).

EPISPADIAS.—Urethra opens on the dorsum of penis. Involves a torsion of the penis. Is usually associated with ectopia vesicæ. TREATMENT by plastic operation in suitable cases.

HYPOSPADIAS.—Urethra opens on the lower aspect of the penis or in the perineum. There are three grades: (1) Meatus opens below the glans; (2) Meatus opens below the penile body; (3) Meatus opens in the perineum. The last is associated with cleft scrotum and defective development of penis and testis.

TREATMENT by plastic operations in the more severe cases.

TORSION OF THE PENIS.—The organ is twisted. Usually combined with epispadias.

DISLOCATION (very rare).—The whole organ is pulled out of its cutaneous coverings, and lies under the skin of the scrotum or groin.

DOUBLE PENIS.—Very rare.

Phimosis.—

1. CONGENITAL.—From a long, narrow prepuce. From a minute preputial orifice. From adhesion of the prepuce to the glans.

SYMPTOMS.—Painful and difficult micturition. Ballooning of the urethra. Dribbling of urine after micturition.

RESULTS.—Eczema of and round the genitals. Stone in the bladder. Cystitis. Dilatation of bladder, ureters, and kidneys. Hernia. Prolapsus recti.

2. ACQUIRED.—From the contraction of fissures at the orifice, from any inflammatory affection of the prepuce.

RESULTS.—Paraphimosis. Rupture of the frænum. Liability to severe forms of venereal disease, or epithelioma.

TREATMENT.—

1. CIRCUMCISION.—In all uncomplicated cases.

Method.—Cut off the prepuce after pulling it forward over the glans. Cut the mucous membrane of the prepuce near to the glans. Sew the edges of skin and mucous membrane with catgut.

Phimosis—Treatment by Circumcision, *continued*.

Errors.—Removal of too much skin: Retracts the penis
—Prevents erection—Liable to ulceration. Removal of too little skin: The phimosis recurs.

2. SLITTING UP THE PREPUCE along its dorsal aspect. In cases in which a chancre or some foul secretion is concealed by the prepuce, or in which paraphimosis has occurred.

Paraphimosis.—

CAUSES.—Constriction of the glans at the corona by a contracted preputial orifice after the prepuce has been drawn back.

SIGNS AND RESULTS.—Pain and oedema. Ulceration at the constricted point. Gangrene of parts below the constriction.

TREATMENT.—Reduction under an anæsthetic. Division of the prepuce along mid-dorsal line if reduction is impossible.

Circumcision: At the time if the parts are healthy. Later if much inflammation exists.

Priapism.—Continuous erection in the absence of sexual desire.

CAUSES.—Venereal excess. Injury or thrombosis in corpora cavernosa. Phimosis or stone in the bladder (children). Leukæmia. Injuries to the cervical spinal cord.

SYMPTOMS.—Pain. Mental distress. In nerve cases there is turgescence without any pain or rigidity.

TREATMENT.—In nerve cases leave it alone.

SEDATIVES: Bromides, antimony, morphia, etc.

INCISIONS into the corpora cavernosa.

Tumours.—

SEBACEOUS CYSTS.

HORNS.—Growing from a ruptured sebaceous cyst.

PAPILLOMA.—Common in gonorrhœa. Usually grow inside the prepuce, or from the glans. Are soft, friable, dendritic masses. There is no infiltration of their base.

Treated by removal with the scissors, touching the base with the cautery. Or by application of calomel.

EPITHELIOMA (*see below*).

SARCOMA (very rare).

Epithelioma.—

CAUSES.—Men over 40. Almost always occurs in conditions of phimosis. Unknown among Jews. Any ulcer, wart, or fissure may give rise to it.

POSITION.—Generally starts in the sulcus behind the corona.

CHARACTER.—(1) Cauliflower-like mass of bleeding warts with indurated base; or (2) A deep ulcer with indurated base and edges, often concealed by the phimosis, with foul sanious discharge,

PROGRESS.—May form an advancing fungating mass or a deep, foul ulcer. Either kind may slough through the prepuce. The urethra is often opened behind the meatus, causing a urinary fistula. Inguinal glands enlarge and often suppurate. The lymphatics may stand out as red lines. A solid cedema may result from lymph obstruction.

DIAGNOSIS.—

PAPILLOMATA.—Have no induration.

CHANCER, or any indurated ulcer with phimosis.—If it does not quickly yield to treatment, slit up the prepuce, remove, and examine.

TERTIARY ULCERATION (so-called relapsing chancre).—Follows a primary chancre. Yields to the action of iodides. Is avascular. There is little or no new growth at the edges.

TREATMENT.—

AMPUTATION THROUGH THE BODY OF THE PENIS.—In early cases confined to the glans.

AMPUTATION OF THE WHOLE PENIS.—In advanced cases. The scrotum is split. The crura are dissected away from the pubes.

COMPLETE REMOVAL OF ALL GLANDS from both groins.

EPITHELIOMA OF THE SCROTUM.

(*'Chimney-sweep's Cancer'*.)

General Characters.—This is a carcinoma of the skin of the scrotum, and it presents as a typical malignant ulcer. The progress is slow, and the inguinal glands are affected late.

Treatment.—Complete removal, together with the inguinal glands.

CONGENITAL ABNORMALITIES OF THE TESTIS.

Polyorchism (more than two testes), **Anorchism** (no testis), and **Monorchism** (one testis), are all very rare.

Retained Testis.—The testis remaining in the abdomen or inguinal canal is common.

DEGREES OF RETENTION.—

Abdominal.—It is attached to the posterior abdominal wall—i.e., true undescended testis.

Iliac.—It lies deep to the internal abdominal ring.

Inguinal.—It lies in the inguinal canal.

STRUCTURE AND SIGNS.—A soft or tender lump exists at the internal ring or in the canal. The scrotum is ill-developed, and empty on that side. The testis is usually soft, ill-developed, and functionless.

COMPLICATIONS.—Hernia usually co-exists. Complete atrophy of the testis. Torsion and gangrene. Orchitis. Hydrocele or hæmatocele. Malignant disease.

Congenital Abnormalities of Testis—Retained Testis, *continued*.

DIAGNOSIS from: Hernia, hydrocele of the cord, and other inguinal swellings.

Absence of the testis from the scrotum is the main clue.

TREATMENT.—*Torek's operation*: Testis is brought down to scrotum, and scrotal wall is incised. Deep fascia on inner side of thigh is now exposed, and raw edge of scrotum and testis is sewn to this (*Fig. 151*). Three months later testis and scrotum are freed from the thigh.

Ectopía Testis.—Testis leaves the inguinal canal in an abnormal position. Various positions: (1) Perineal; (2) Crural; (3) Near the anterior superior spine; (4) Pubic; (5) Prepenile.

TREATMENT.—Removal if it is painful or inflamed.

Torsion of the Spermatic Cord.—The testis is rotated once or twice and the cord is twisted. The twisted cord causes strangulation of the vessels. It probably arises from conditions of imperfect descent and development.

ANATOMY.—Great swelling and ecchymosis of the epididymis. The body of the testis is comparatively normal. Possible gangrene of the whole organ.

SYMPTOMS.—Sudden sickening pain in the groin. Great swelling of testis and cord below strangulation. Vomiting and collapse.

DIAGNOSIS.—From strangulated hernia. By the following points: Any evidence of non-descent of the testis. The epididymis being in front of the testis. A normal part of the cord above the swelling. Absence of constipation.

TREATMENT.—Removal of the testis and cord. Replacement is seldom desirable or justifiable.

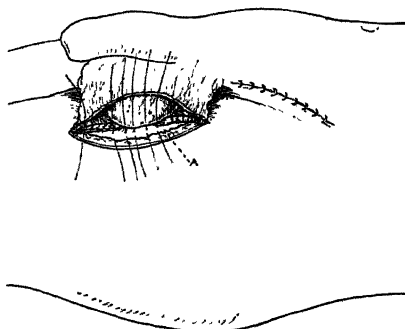


Fig. 151.—Torek's operation for undescended testicle. A, Testicle sutured to fascia of thigh.

VARICOCELE.

Definition.—A marked hypertrophy and varicosity of the spermatic veins.

Etiology.—It always occurs on the left side. The reasons for this are unknown, but may be: (1) Lower position of testis; (2) The opening of the left spermatic vein into the renal vein instead of direct into the vena cava; (3) A congenital anomaly.

Symptoms.—Often there are none. A dragging pain, especially after excretion or copulation. When once the patient's attention has been attracted to it, hypochondriacal symptoms are common. It debars from public service.

Signs.—The large mass of veins is easily felt in the scrotum. They feel like a 'bag of worms'. They empty when the patient lies down, and they give an impulse on coughing or straining. The testis is often small and soft.

Treatment.—Removal between double ligatures in patients entering for the public services or in those who have much pain. Suspensory bandage in other cases.

HYDROCELE.

Definition.—A collection of serous or spermatic fluid connected with the testis, cord, or their coverings.

Varieties (*Fig. 152*).—

I. VAGINAL, i.e., in a normal or abnormal tunica vaginalis.—

1. CONGENITAL.—In the whole funicular and vaginal tunics, whose cavity communicates with the peritoneum.
2. INFANTILE.—Similar to the congenital, but shut off from the peritoneum at the internal ring.
3. BILOCULAR.—In an abnormal, bilocular, funicular sac.

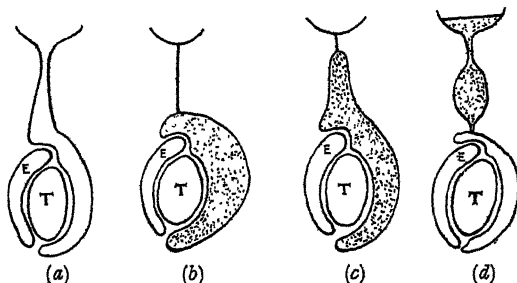


Fig. 152.—Diagrams of hydrocele: (a) Congenital hydrocele; (b) Vagina hydrocele; (c) Infantile hydrocele; (d) Congenital funicular hydrocele. T, Body of testis; E, Epididymis.

Hydrocele—Varieties—Vaginal, *continued*.

4. ACQUIRED :—

a. *Primary*.—A chronic affection of the tunica vaginalis itself.

b. *Secondary*.—May be acute or chronic, secondary to disease or injury of the testis or epididymis, or following operations such as for varicocele or inguinal hernia.

II. HYDROCELE OF THE CORD, usually funicular.—

1. ENCYSTED HYDROCELE OF THE CORD.—Arises in an unobliterated part of the funicular process shut off from the tunica vaginalis below.

2. FUNICULAR HYDROCELE.—Arises in the patent funicular process.

a. *Congenital*.—Communicates with the peritoneum.

b. *Infantile*.—Is shut off from the peritoneal cavity.

3. DIFFUSE HYDROCELE OF THE CORD.—A condition of lymphatic œdema.

III. HYDROCELE OF THE TESTIS AND EPIDIDYMIS.—

1. ENCYSTED HYDROCELE OF THE EPIDIDYMIS.—From a dilatation in the spermatic ducts.

2. ENCYSTED HYDROCELE OF THE TESTIS.—Arises beneath the tunica albuginea.

IV. HYDROCELE OF A HERNIAL SAC.—In infancy this will be a congenital hydrocele. In adults a similar condition may arise in the sac of a hernia after its contents have been reduced.

Primary Chronic Vaginal Hydrocele.—

CAUSES.—Practically unknown. Probably some inflammatory thickening of the tunica vaginalis.

STRUCTURE.—Tunica vaginalis becomes thickened in proportion to the age of the hydrocele. It may become fibrous, cartilaginous, or calcified. Fibrous or warty growths may be found free in the cavity or growing from the surface of the tunic.

The fluid is usually about 4 to 12 oz.; sp. gr. 1025, neutral reaction, 6 per cent albumin. Coagulates when mixed with a little blood. It is usually clear straw-coloured. It may be green (blood pigments), turbid (mucous), or shimmering (cholesterin crystals).

ANATOMY.—The enlarged tunic surrounds the testis, which lies at the back and lower part of the swelling (*Fig. 153, a*). The enlargement distends the scrotum, and has but little or no tendency to travel up the cord.

SIGNS AND SYMPTOMS.—A scrotal swelling with the following characters: Large size, but of slow formation. Absence of much pain or tenderness. Feels smooth on the surface, is globular or pyriform. Elastic or fluctuating in proportion to thinness and tenseness of the sac.

Translucency. This may be absent: when the fluid contains much blood or mucus; if the tunica vaginalis is very thick; if many adhesions exist inside the sac.

It is dull to percussion. There is no impulse on coughing. It is bilateral in about one case in five.

DIAGNOSIS.—

HERNIA.—In this there are: A swelling which extends into the inguinal region. Impulse, reducibility, gurgling, resonance. An irreducible epiplocele is the most difficult to distinguish. The obscurity of the cord, the doughy feel, and the opacity, are the chief points. The two conditions may co-exist.

HÆMATOCELE.—Feels harder, heavier, and less elastic. Is not translucent. Often a history of injury. There may be some ecchymosis.

SOLID ENLARGEMENTS OF THE TESTIS AND EPIDIDYMIS.—These are opaque and do not fluctuate. The outline of the body and epididymis is usually to be felt. Pain and tenderness are generally marked. The cord is often thickened. In inflammatory enlargements of the organ a secondary hydrocele may be present, but inflammatory signs are evident.

A sarcoma is the most difficult to distinguish, because it is often so elastic.

OTHER VARIETIES OF HYDROCELE.—Hydroceles of the cord and epididymis and testis leave the body of the testis unobscured. Congenital and infantile hydrocele run up to the internal ring, the congenital variety being reducible.

TREATMENT.—

TAPPING.—Make sure of the position of the testis. Drive the trocar upwards and backwards so as to clear the testis. It has to be repeated every few months.

INJECTIONS of strong antiseptics after tapping. Linimentum iodi ʒij, water ʒiv; or pure carbolic and glycerin, aa ʒj.

EXCISION of part or whole of the sac. Especially indicated when the fluid reaccumulates very quickly after tapping, or when the sac is thick.

EVERSION OF THE SAC.—The hydrocele is exposed and an incision made into it just large enough to allow the testicle to be brought out through it. The sac is now turned inside out and secured with a stitch. The everted sac and testicle are then returned to the scrotum.

Secondary Chronic Hydrocele.—Of small size, merely obscuring the testicular outline. Secondary to syphilis, tubercle, or chronic inflammation.

TREATMENT is that of the primary disease. Firm strapping may be useful.

Acute Hydrocele.—Always secondary to some injury or disease of the testis. Gonorrhœa, traumatic orchitis, or wounds may

Acute Hydrocele, continued.

cause it. Usually is absorbed spontaneously, leaving adhesions. Very rarely suppurates.

TREATMENT is that of the primary disease.

Congenital and Infantile Hydrocele.—Translucency is well marked. The swelling extends into the groin. Congenital hydrocele is slowly reducible.

TREATMENT.—Usually disappears spontaneously. Tapping (in infantile), followed by a truss. Injections are dangerous. Operate only if a hernia co-exists.

Bifocular Hydrocele.—A form of infantile hydrocele. The open funicular process has a secondary pouch opening from it. This may lie between the peritoneum and muscles, between the muscles, or between the skin and muscles.

TREATMENT.—By open incision, dissecting out as much as possible.

Hydrocele of the Cord.—A fluid swelling above and separated from the testis. Congenital form is reducible into the peritoneum. Infantile form extends into the inguinal canal, but is irreducible. Encysted form is a globular enlargement at one part of the cord. It may be multiple. Commoner on right side than on left.

In addition to translucency and fluctuation, all these are distinguished by moving with traction on the testis. And usually an upper limit can be defined, so distinguishing them from herniæ.

TREATMENT.—Acupuncture or excision.

Encysted Hydrocele of the Epididymis.

FORMED BY A DILATATION OF ONE OF THE DUCTS, or foetal tubes, at the head of the epididymis.

USUALLY CONTAINS ALTERED SPERMATIC FLUID. It is alkaline, with little or no albumin. Opaque, milky appearance. It effervesces with acetic acid. It contains many living or degenerate spermatozoa.

It forms a swelling ABOVE AND DISTINCT FROM THE TESTIS and tunica vaginalis.

Rarely contains more than a few ounces of fluid.

Encysted Hydrocele of the Testis.—Situated beneath the tunica albuginea. Usually of quite small size. Resembles the last variety when it becomes large.

TREAT both this and the last by acupuncture or excision.

HÆMATOCELE.

Definition.—A blood collection in the tunica vaginalis or cord.

Varieties.—Vaginal: the only common variety. Diffuse in the cord: from ruptured vessel. Encysted in testis, epididymis, or cord: arises from bleeding into the corresponding hydrocele.

Causes.—Contusion of the testis. Contusion or puncture of a hydrocele. Secondary to malignant disease.

Structure.—Massive thickening of the walls of the tunica vaginalis with patches of cartilage or calcareous material. Filled with old and laminated clot, with, perhaps, a little fluid. The testis is often degenerated.

Signs and Symptoms.—An oval tumour, which envelops both testis and epididymis. It is not translucent, and feels solid or doughy. There is history of either a trauma or a hydrocele. Ecchymosis may be well marked in recent cases. The cord is not thickened. The size is stationary or nearly so.

Diagnosis.—

FROM HYDROCELE.—This is fluctuating and translucent. Puncture yields clear fluid.

FROM TRAUMATIC ORCHITIS.—Diagnosis is very difficult. In this the outline of testis and epididymis can often be made out. Tenderness is much more marked.

FROM SARCOMA, GUMMA, OR OTHER NEW GROWTH.—These steadily increase in size. In their early stages the testis and epididymis can be distinguished.

In all doubtful cases it is better to explore.

Treatment.—Palliative in the acute cases after trauma—rest, elevation, and lotions. Operative in chronic cases. Turn out the clot, and excise the sac. Castration in old men with degenerate testis and much pain.

INFLAMMATORY DISEASES OF THE TESTIS AND EPIDIDYMIS.

Varieties.—

EPIDIDYMITIS.—

ACUTE OR CHRONIC.—(1) Simple. (2) Pyogenic. (3) Gonorrhœal. (4) Tuberculous. (5) Syphilitic.

ORCHITIS.—

ACUTE.—(1) Traumatic. (2) Complicating a specific fever.

CHRONIC.—(1) Resulting from the acute form. (2) Syphilitic (3) Tuberculous.

EPIDIDYMO-ORCHITIS.—Begins as an orchitis. Usually traumatic.

EPIDIDYMITIS.

Acute Epididymitis.—

CAUSES.—Some primary inflammation of the posterior urethra, prostate, or bladder, viz.: Gonorrhœa—Gouty urethritis—Septic catheterization—Stricture—Prostatitis—Cystitis—*B. coli* pyelitis. It also occurs fairly commonly after enucleation of the prostate.

Acute Epididymitis, continued.

ANATOMY.—Epididymis is much swollen, the tail being chiefly affected (*Fig. 153, b*). Vas is generally swollen. Tunica vaginalis may be inflamed, and its fluid increased to form an acute hydrocele.

SIGNS AND SYMPTOMS.—A boat-shaped swelling behind the testis which is very tender, and most marked at the lower end. The scrotum is red, inflamed, and often adherent. There may be a fluid swelling obscuring the testis, from affection of the tunica vaginalis. The vas is swollen, tender, and painful. General malaise, with rise of temperature. Extreme tenderness. Walking with the legs abducted. Acute stage lasts one or two weeks. Often leaves a nodular thickening in the globus minor. The urethral discharge generally diminishes in acute stage. One side is affected after the other.

SEQUELÆ.—Chronic epididymitis. Abscess (very rare). Sterility in bilateral cases.

TREATMENT.—Rest in bed, with support to the scrotum. Evaporating lotions. Hot fomentations if great pain exists. Do not give any urethral injections.

Chronic Epididymitis.—

VARIETIES.—Simple: is commonly gonorrhœal. Tuberculous. Syphilitic (*see below*).

CAUSES.—The same as in acute epididymitis. Generally is the remains of an acute attack. Sometimes is chronic from the first.

SYMPTOM.—Dragging pain in the testis.

SIGNS.—An induration and swelling of the epididymis and vas. Most marked at the tail, i.e., the globus minor. May affect the entire epididymis. The globus minor is affected first in gonococcal infections, the globus major in syphilitic infections.

RESULT.—Often produces sterility if bilateral.

TREATMENT.—Strapping and suspension of the testis

ORCHITIS.

Whereas epididymitis seldom spreads to the body of the testis, inflammation of the body often spreads to the epididymis.

Traumatic Orchitis.—Often affects both epididymis and testis. Results from crushes and contusions. Consists of hæmorrhagic and fibrinous masses in the substance of the testis and epididymis. The organ is enlarged, very hard, nodular, and tender. Usually leaves a chronic nodular thickening. May result in atrophy.

TREAT by strapping and suspension.

Acute Orchitis.—

CAUSES. — Traumatism. Infective fevers: Mumps — Enteric — Variola — Tonsillitis — Scarlet fever — Malaria — Influenza. Rheumatism — Gout.

SIGNS AND SYMPTOMS (of the only common form, viz., that in mumps).—Occurs in young adults. Begins about a week after the parotitis. Testis swells to two or three times its natural size (*Fig. 153, c*). It retains its shape, and is firm and elastic. It is intensely tender and painful. One side may be affected after the other. High fever and prostration occur for a few days, but soon subside. Suppuration almost never occurs in parotitic forms, but may in variola, enteric, rheumatism, or gout. Atrophy is very rare as a sequel.

TREATMENT.—Constitutional treatment, rest in bed, etc. Cooling lotions in most cases. Fomentations in gout or rheumatism.

SYPHILIS OF THE TESTIS.

Varieties.—(1) Congenital. (2) Acquired: (a) Secondary, and (b) Tertiary.

1. **Congenital.**—Occurs as a bilateral gummatous orchitis. Syphilis is practically the only cause of testicular enlargement before the age of six months. Later the testicle shrinks and becomes fibrotic, so that in an adult a shrunken testicle without history of previous injury is very suggestive of congenital syphilis. Such persons are impotent (Hutchinson's tetrad—'the halt; the blind; the deaf; the impotent'). May occur as a gummatous infiltration about puberty.

2. **Acquired.**—

a. **SECONDARY.**—Transitory symmetrical epididymitis mainly affecting the globus major—'reminders'. Readily disappears after giving mercury, but may leave a fibrous nodule.

b. **TERTIARY.**—

PATHOLOGY.—May occur as a localized gumma with interstitial orchitis, or as a gummatous infiltration (*Fig. 154, a*). The testicle becomes replaced by fibrous tissue in which gummatous caseation occurs. This adheres to the scrotum and breaks through anteriorly, forming an ulcer or fungus testis. There may be a secondary hydrocele.

SIGNS.—Slow, steady enlargement of body of the testis. Mass is nodular, heavy, painless, and without testicular sensation. A secondary hydrocele may coexist. An ulcer or fungus may be present. There is a slight diffuse thickening of the cord (cremaster and vessels).

TREATMENT.—Iodides, with mercury. If evidence of caseation exists, remove the testicle so as to avoid fungation.

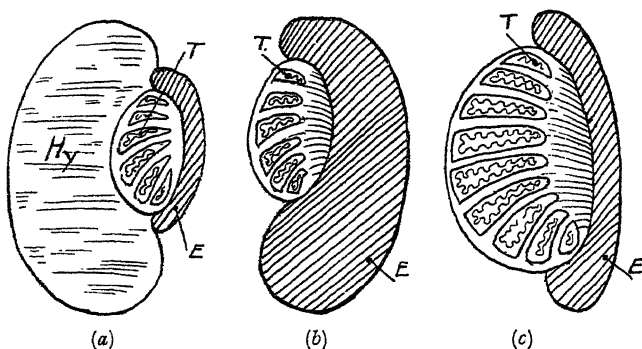


Fig. 153.—Affections of the testicle. (a) Hydrocele of the tunica vaginalis. (b) Epididymitis. (c) Orchitis. T, Testis; E, Epididymis; Hy, Hydrocele.

(After Rose and Carless)

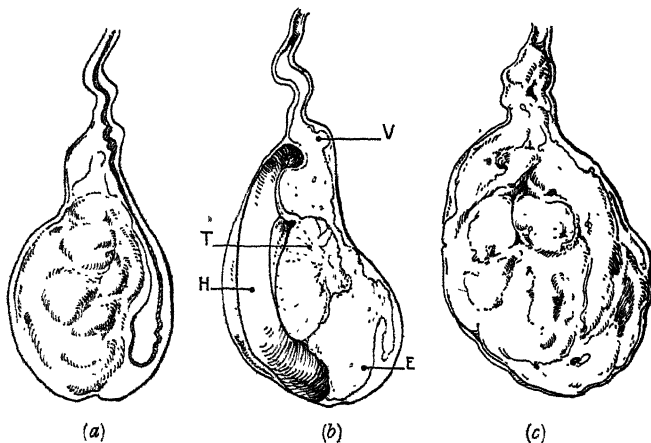


Fig. 154.—Affections of the testicle. (a) Gumma, affecting body, but not vas or epididymis. (b) Tubercle. H, Hydrocele; T, Body of testis, unaffected; E, Epididymis and V, Vas, affected. (c) New growth, affecting body, epididymis, and vas.

TUBERCULOUS DISEASE OF THE TESTIS.

Etiology.—Occurs in young adults, or even in young children. May be a primary tuberculous lesion, or more often is secondary to disease elsewhere, especially bladder, prostate, vesiculæ, kidneys, or lungs.

PREDISPOSING CAUSES: Any injury of the testis, especially gonorrhœa or traumatic orchitis.

Pathology.—

EPIDIDYMIS is affected first almost invariably.

THE GLOBUS MAJOR is the earliest seat of the disease. If the globus minor is first affected, then the disease is probably secondary to tuberculous disease of the seminal vesicles or prostate.

NODULAR INFILTRATION, CASEATION, and FISTULA FORMATION succeed each other. In chronic or cured cases, and especially in children, a hard fibrous mass of scar tissue is left permanently.

THE DISEASE MAY EXTEND into the following tissues: Vas deferens, vesiculæ seminales, prostate, tunica vaginalis (producing hydrocele, or obliteration by adhesions), scrotum (forming a fistula or fungus), the body of the testis (rarely), the bladder, and the kidneys. (*Fig. 154, b.*)

Signs.—EPIDIDYMIS SHOWS NODULAR THICKENING, first about the head, then the tail, then the body. These are hard and not inflamed at first. After several weeks, or months, softened areas are felt.

THE SKIN OF THE SCROTUM becomes red and adherent, and the abscess breaks, discharging tuberculous pus.

A FISTULA or FUNGUS TESTIS results.

The tunica vaginalis at first is filled by a small hydrocele. Later it is usually obliterated by adhesions.

The fungus, or fistula, may open behind without involving the tunic, or it may first invade the tunic, and then open in front.

The opposite testis generally is involved later on, and will present an earlier stage of the same disease.

THE VAS is felt as a thickened cord.

THE PROSTATE AND SEMINAL VESICLES may be felt to be thickened and nodular per rectum.

Course.—As in tuberculous disease elsewhere, the rate of progress varies much. Usually it is a slow process, lasting many months. Death occurs generally by infection of the bladder, kidneys, or lungs. Cases may become chronic, and a curative fibrosis take place. In this case the ducts will almost certainly be obliterated, and therefore for reproductive purposes the testis is functionless.

Tuberculous Disease of the Testis, *continued*.

Treatment.—

MEDICAL TREATMENT in chronic or slight cases, with, in addition, injections of tuberculin.

CASTRATION early in the disease, when secondary deposits are absent, in the hope of a radical cure; or late in the disease, for the relief of fistulæ or fungus.

EPIDIDYMECTOMY.—In bilateral cases, in order to preserve the general influence of the glands.

As extensive removal of the vas as possible should always be done, and in some cases, the iliac and lumbar lymph-glands. Diseased vesiculæ seminales may be removed by the perineal route if the bladder and kidneys are sound.

If the bladder and kidneys are affected it is useless to operate, except as a palliative measure for fungus or fistulæ.

NEW GROWTHS OF THE TESTIS.

Pathology.—All new growths of the testicle must be regarded as malignant. Tumours described as fibroma, adenoma, chondroma, lipoma, and myoma are either the predominating constituents of a mixed growth, or are so rare as to be of no clinical value. A teratoma may remain stationary for years, but eventually takes on rapid growth.

VARIETIES.—

1. **TYPICAL TERATOMA OR FIBROCYSTIC DISEASE.**—This tumour contains all three primary layers—epiblast, mesoblast, and hypoblast.
2. **ATYPICAL TERATOMA.**—This is the malignant stage of the typical teratoma. One of the primary layers develops and predominates at the expense of the other two layers.
3. **CARCINOMA, SEMINOMA, OR SPERMATOCYTOMA.**—This is a spheroidal-celled tumour arising from the spermatocytes of the second order in the germinal layer of the seminiferous tubules.
4. **CHORION CARCINOMA.**—This probably arises by a process of metaplasia from the epiblast of a teratoma.
5. **SARCOMA.**—A pure sarcoma is very rare. The majority of the cases described are probably atypical teratomata in which the mesoblastic tissue predominates.

Etiology.—The average age is about 30.

Symptoms.—In the early stages there is neither pain nor discomfort, but a steady increase in size of the testicle. The enlargement does not at first involve the epididymis, which can be felt separate from the testicle. Rounded nodular swellings may be felt as the tumour increases in size (*Fig. 154, c*). The testicle

feels heavy and is usually very hard and insensitive. If rapidly growing with extensive degeneration it may give an impression of fluctuation. Metastases occur in the lumbar aortic glands and form a deep-seated mass at or above the level of the umbilicus. Metastases may occur in the lungs.

Diagnosis.—

CHRONIC HÆMATOCELE.—May have a history of injury and subsequent increase in size, with acute pain.

GUMMA.—Rapid improvement with antisyphilitic treatment.

HYDROCELE.—If old may not be translucent. History of tapping may confirm diagnosis.

Often the diagnosis is impossible without exploration.

Treatment.—Castration, with removal of the spermatic cord up to the internal abdominal ring—i.e., remove the tumour during the fibrocystic or innocent stage. Prognosis for other cases is bad, but castration should be performed, together with retroperitoneal removal of the lymphatics and glands up to the level of the renal vein. This is done by prolonging the incision through the lateral abdominal muscles.

CHAPTER LI.

THE DIAGNOSIS OF SWELLINGS IN THE INGUINO-SCROTAL REGION.

In the region of the groin and scrotum so many diverse swellings may appear that their differentiation is often a matter of difficulty. In order to meet this, it is important to bear in mind, first, the different groups of diseases that may occur, and second, the importance of a systematic examination of the parts. It is particularly desirable that the affected side should be compared with the unaffected, that the patient should be examined, first standing up, and then lying down, and that he should be placed facing a good light, so that light and shade are symmetrically distributed on both sides.

Classification of Conditions.—

1. HERNIA.—

ANATOMICAL VARIETY.—Inguinal (oblique, direct, congenital, funicular) or femoral.

NATURE OF CONTENTS.—Gut, viscus—e.g., ovary or bladder—omentum, or fluid.

PATHOLOGICAL CONDITION.—Irreducibility, obstruction, strangulation.

2. AFFECTIONS OF THE SPERMATIC CORD.—

HYDROCELE (congenital, encysted, diffuse).

SOLID TUMOURS, e.g., lipoma.

EXTENSION FROM TESTICULAR SWELLING—malignant or tuberculous.

VASCULAR.—Inguinal varix.

3. AFFECTIONS OF THE TESTIS AND ADNEXA.—

HYDROCELE.—Vaginal, primary, secondary, encysted, etc.

INFLAMMATORY.—Acute or chronic orchitis and epididymitis.

SPECIFIC.—Syphilitic and tuberculous disease.

TRAUMATIC.—Epididymo-orchitis.

VARICOCELE.

NEW GROWTH.

4. AFFECTIONS OF THE SKIN AND SUBCUTANEOUS TISSUES.—

Elephantiasis, œdema, extravasation of urine, epithelioma, sebaceous or dermoid cysts, warts, horns, syphilitic or tuberculous eruptions.

5. GLANDULAR.—
 INFLAMMATORY.—Secondary to irritation or sepsis in the leg, genitals, perineum, or abdomen.
 SPECIFIC.—Tuberculous, syphilitic.
 NEW GROWTH.—Lymphadenoma, epithelioma, melanotic sarcoma.
6. ABSCESS.—
 GLANDULAR.—From the suppuration of any of the last mentioned.
 PSOAS OR ILIAC.—Tracking beneath Poupart's ligament.
 PELVIC (e.g., parametric).—Tracking through the inguinal canal.
 HIP DISEASE.—In Scarpa's triangle.
7. MISPLACED VISCUS (other than herniae).—
 RETAINED TESTIS, or ECTOPIA TESTIS, with any of its complications.
 OVARY in the inguinal or femoral canal.
8. VASCULAR SWELLINGS.—
 ARTERIAL.—Aneurysm of the iliac or femoral arteries.
 VENOUS.—Varix of the inguinal, testicular, or saphenous veins.
 LYMPHATIC—Hygroma.
9. BURSAL.—Psoas bursa over the hip-joint.
10. SARCOMA OF BONES.—May grow from any part of the pelvis or femur.

Differentiation of the Different Structures normally present.—The following parts should be systematically examined in order to determine the extent of the disease, and gain information as to its character.

The skin, especially of the scrotum.	The penis and urethral orifice.
The body of the testis.	The tunica vaginalis.
The epididymis and vas.	The spermatic veins.
The inguinal canal and its contents.	The lymph-glands.

The History of the Swelling in relation especially to :—

Time and mode of onset.	Gonorrhœa.
Syphilis.	Trauma.
Tuberculous disease.	Sepsis.

The Position of the Swelling.—

PURELY SCROTAL SWELLINGS.—

IN THE TISSUES OF THE SCROTUM.—Gumma, epithelioma, cysts, extension from disease of the testis.

IN THE BODY OF THE TESTIS.—The mass is chiefly solid, and the epididymis cannot be differentiated. Orchitis (especially that associated with parotitis), traumatic lesions, gumma, carcinoma, sarcoma, cystic disease.

632 DIAGNOSIS OF INGUINO-SCROTAL SWELLINGS

Diagnosis of Purely Scrotal Swellings, *continued*.

IN THE EPIDIDYMISS.—When the body of the testis can be distinguished from the epididymis the swelling is usually primary in the latter. Epididymitis, tubercle, syphilitic nodules.

IN THE TUNICA VAGINALIS.—Fluid, fluctuating, generally translucent swellings obscuring the outline of the testis and epididymis. Vaginal hydrocele, primary or secondary; hæmatocele. It is important always to examine the testis after the evacuation of the hydrocele fluid, so as not to overlook a primary disease of that organ.

ENCYSTED HYDROCELE.—A fluid translucent swelling, distinct from the body of the testis. Encysted hydrocele of the testis, epididymis, or cord.

VARICOCELE.—A vermiform swelling distinct from the testis and vas.

PURELY INGUINAL SWELLINGS.—

IN THE INGUINAL CANAL.—Hernia, retained testis, hydrocele of the cord, tumours of the cord, inguinal varix.

The fact that an inguinal swelling affects the cord is shown by its movement on pulling the testis.

SUPERFICIAL TO POUPART'S LIGAMENT.—Lymph-glands.

ILL-DEFINED inflammatory swellings arising in the glands or coming from the pelvis.

CRURAL SWELLINGS.—Femoral hernia, aneurysm, saphenous varix, hip abscess, psoas bursitis.

INGUINO-SCROTAL SWELLINGS are distinguished by the fact that the scrotal swelling is continuous with one which occupies the inguinal canal.

INGUINAL HERNIÆ.—These descend from above downwards. Usually give an impulse on coughing, are reducible, and may be resonant to percussion.

HYDROCELE.—A large vaginal hydrocele may spread up the cord. Hydrocele of the cord. Congenital or infantile hydroceles. All are fluctuating and translucent.

INFLAMMATORY, TUBERCULOUS, and MALIGNANT swellings spread up from the epididymis to the cord.

SPERMATIC VARICOCELE may be associated with one in the inguinal region.

SWELLINGS WITH INDEFINITE OR EXTENSIVE LIMITS.—

PSOAS OR ILLIAC ABSCESS.

SARCOMA OF BONES.

CYSTIC HYGROMA.

EXTRAVASATION OF URINE.

Examination of Associated Structures.—This often gives the clue to the nature of the disease in obscure cases. The most important structures to be examined are:—

THE PENIS AND URETHRA, for evidence of syphilis or gonorrhœa.

THE SKIN of the abdomen, legs, genitals, perineum, and anus, for septic or malignant disease.

DIAGNOSIS OF INGUINO-SCROTAL SWELLINGS 633

THE SPINE AND HIP, for evidence of tuberculous disease.

THE PROSTATE AND VESICULÆ SEMINALES, for any thickening or tenderness, which may be due to inflammatory or tuberculous disease.

Physical Examination of the Swelling.—

PHYSICAL CHARACTERS ON PALPATION.—

SOLID SWELLINGS are those of the testis and epididymis, whether inflammatory, new growth, tubercle, or syphilis. Glandular masses, septic, syphilitic, tuberculous, or new growth. Bony sarcomata.

FLUCTUATING SWELLINGS are hydroceles, hæmatoceles, abscesses, cysts, and gummata.

ELASTIC SWELLINGS, difficult to distinguish from fluctuating, may be sarcoma or gumma of the testis.

DOUGHY.—Herniæ, especially epiploceles.

HARD, HEAVY, AND INDOLENT, especially diffuse gummata of testis and some forms of new growth.

TENDER AND INFLAMED.—Epididymitis, bubo and other septic glandular swellings, torsion of the testis, inflamed or strangulated hernia, any acute abscess.

REDUCIBILITY.—

THE POSSIBILITY OF REDUCTION into the abdomen proves the swelling to be a hernia, varicocele, saphenous varix, or congenital hydrocele.

THE DIRECTION OF REDUCTION may help to distinguish between an oblique inguinal hernia, which goes upwards and outwards; a direct inguinal hernia, which goes backwards; and a femoral hernia, which goes downwards and then upwards.

THE MANNER OF REDUCTION.—A hernia slips back suddenly, and that containing gut usually gurgles. A congenital hydrocele is reducible very slowly and gradually. A venous swelling is more easily reduced by the patient lying down than by pressure.

THE RECURRENCE AFTER REDUCTION is from above downwards in the case of a hernia, but from below upwards in the case of a varix or congenital hydrocele.

TRANSLUCENCY.—This is well marked in those hydroceles which can be subjected to the test. In old thick hydroceles and in those of the cord it is difficult to obtain.

IMPULSE ON STRAINING.—This is seen in herniæ (if they are not inflamed or irreducible), varicocele, saphenous varix, and some swellings of the cord.

EXPANSILE IMPULSE is peculiar to reducible herniæ, and is rarely seen in congenital hydrocele.

A MERELY PUSHING IMPULSE may be seen in any tumour in the inguinal canal, e.g., a retained testis.

CHAPTER LII.

AMPUTATIONS.

Introductory.—Removal of a limb or of a part of it was a very common operation in the old days before the advent of aseptic surgery made conservative measures generally possible. The classical amputations of a generation ago were invented when speed was one of the chief considerations, the patient not having the advantage of anæsthesia. In modern times amputations are comparatively uncommon, and the great majority of the older methods have been abandoned in favour of a few simple types. This is because the art of the limb-maker has improved, and it has been found, especially since the experiences of the War, that only those types of amputation after which an artificial limb can be fitted are worth while doing.

Indications for Amputation.—

TRAUMA.—Crushes of a part of the limb. Extensive tearing of the soft parts, as in machinery accidents. Open fractures, with concomitant injury to joints or blood-vessels.

GROSS DEFORMITY.—Mal-united fractures, especially when involving joints. Rarely in infantile paralysis or Charcot's disease.

GANGRENE.—All types of gangrene require removal of the dead part of the limb. But in some cases of senile gangrene, if painless, it is better to allow the part to be separated by natural ulceration, because surgical amputation would require removal high up through healthy tissues.

SEPSIS OR TUBERCULOSIS.—When the bones and joints are infected and fail to recover with conservative treatment.

CHRONIC ULCERATION (of the leg).—When an ulcer has destroyed more than half the circumference of the leg, or short of this has relapsed after conservative or plastic treatment.

MALIGNANT DISEASE.—Usually sarcoma of bone.

PRIMARY OSTEOGENIC SARCOMA.—High amputation of the whole limb.

MYELOMA.—(If conservative measures have failed.) Local amputation.

CHONDROMA.—When the tumour has destroyed the usefulness of the limb.

EPITHELIOMA OF THE SKIN.

Site of Amputation.—

Above the disease to be removed.

Through healthy tissues with good circulation.

In upper limb, so as to save any part of the digits or palm of the hand which is viable.

In lower limb, so as to adapt the stump to the best form of artificial leg.

Technique of Amputation.—

INCISION.—

CIRCULAR OR ELLIPTICAL, TURNING UP A CUFF OF SKIN.—When bone is central and when there is to be no weight-bearing.

RACKET-SHAPED.—At the shoulder or hip when main blood-vessels have to be secured as the first stage of the amputation.

WITH FLAPS.—Where the bone is not centrally placed and where it is desirable to leave the scar at the side and not at the end of the stump.

LENGTH OF SKIN CUFF OR FLAPS.—

There must be enough skin to cover the stump without tension, Flaps must together exceed in length the diameter of the limb at the point of bone section.

Skin cuff must exceed in length the half diameter of the limb at point of bone section.

HÆMOSTASIS.—

PRELIMINARY TOURNIQUET in all cases except the shoulder and hip.

TIE ALL OPEN VESSELS after amputation, then remove tourniquet and tie any bleeding points.

MUSCLES.—Cut all muscles with oblique clean cuts, and if possible sew together the cut surfaces of opposite muscles before closing wound, so as to avoid dead spaces.

NERVES.—Pull down the main nerves, crush in a clamp, and ligature through the crushed area so as to confine the nerve-fibres inside the nerve-sheath.

BONE.—Divide the periosteum lower than the bone, turn back a cuff, and suture over the bone, so as to avoid the growth of periosteal bone-spurs.

CLOSURE OF WOUND.—

SEW UP, SEPARATELY, periosteum, muscles, fascia, and skin, so as to obliterate dead spaces and to provide a snug covering to the bone.

DRAINAGE is indicated when oozing cannot be checked or when sepsis has been present.

Gaillotine Amputation.—This was used extensively in the war for fulminating septic conditions. It is probably never justified. The limb was 'chopped off' by a circular cut which divided all tissues at the same level. The dressing of the large wound is very painful, and a secondary amputation is always necessary.

Guillotine Amputation, *continued*.

The object of this amputation can be attained by the ordinary circular amputation, dividing the bone higher than the skin by rather more than half the limb diameter.

The skin is pulled down by adhesive plaster and the wound packed with flavine gauze or vaseline gauze.

After-treatment.—

DURING HEALING OF THE WOUND.—The limb should be kept in a suitable splint, e.g., a Thomas's, so as to prevent contracture (this applies especially to amputations below the knee).

WHEN THE WOUND HAS HEALED.—In the case of the lower limb the patient should be encouraged to walk, first with a Thomas splint and later (in about 6 weeks) with a temporary artificial limb.

THE PYLON is a cheap and easily made temporary limb, formed of two ash-laths ending in a wooden cylinder and tipped with a rubber end (*Fig. 155*). It is fixed to the limb by a plaster bandage, the stump being free from pressure.

THE ARTIFICIAL LIMB should be fitted about 3 to 6 months after amputation, when the stump has shrunk to its final size and is free from tenderness.

WHEN WOUND BECOMES SEPTIC.—When amputation is done for septic conditions, e.g., open fractures or osteomyelitis, the wound is liable to become septic. It is important to treat such a condition promptly and efficiently, in order to avoid a re-amputation at a higher level.

REMOVE THE STITCHES FREELY until the depths of the wound can be packed with gauze soaked in flavine solution (1-1000) or permeated with Carrel-Dakin tubes.

APPLY ADHESIVE PLASTER TO THE SKIN and fix the ends of the strips by weight traction (2 to 4 lb.) or tie them to the end of a Thomas splint placed over the limb. In this way retraction of the soft parts will be prevented and the amount of bone lost by necrosis will be reduced to a minimum. (*Fig. 156*.)

SPECIAL AMPUTATIONS.**Fingers and Thumb.—**

FOR PRESERVATION OF A WORKING DIGIT.—If the digit has to be preserved—e.g., in the thumb, or index finger, or when other fingers have been lost—the amputation is done by a *long palmar flap* which covers the end of the stump (*Fig. 157, A*).

FOR REMOVAL OF A DIGIT.—When the digit has to be taken away because of disease or because it is useless, then a *racket-shaped incision*, with the handle of the racket on the dorsum, is the best (*Fig. 157, B*). The digit is disarticulated at the knuckle-joint. Rarely the corresponding metacarpal bone is also removed (*Fig. 157, C*).

Hand.—As amputation of the hand is always done for injury or gangrene, no formal lines can be laid down. Cut the flaps where healthy skin exists, choosing that from the palmar surface by preference (*Fig. 157, D*).

Forearm and Arm.—A *circular or elliptical incision* is the rule. A cuff of skin is turned up and the muscles divided at a level higher than the skin (*Fig. 158, C*).

If removal of the whole forearm is required, it is better to amputate above the condyles rather than through the elbow, because the lower end of the humerus forms a bulbous stump, and because the artificial limb can have its joint at the level of the normal elbow (*Fig. 158, B*).

Shoulder.—Use a *racket-shaped incision*. Begin at the coracoid process and cut down along the anterior border of the deltoid. Find and ligature the great vessels. Cut round the arm at the level of the anterior axillary fold (*Fig. 158, A*).

Forequarter Amputation.—Removal of the outer half of the clavicle and the scapula with the arm.

Make a *racket-shaped incision* with the handle along the line of the clavicle, the circular part surrounding the shoulder at the level

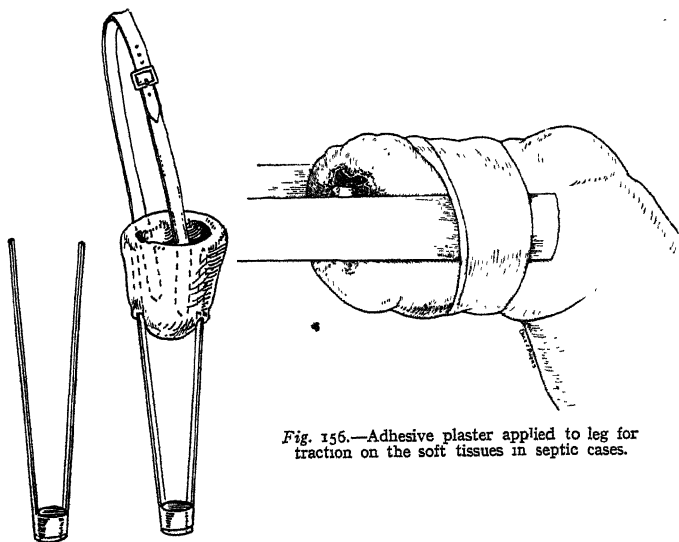


Fig. 155.—The pylon.

Fig. 156.—Adhesive plaster applied to leg for traction on the soft tissues in septic cases.

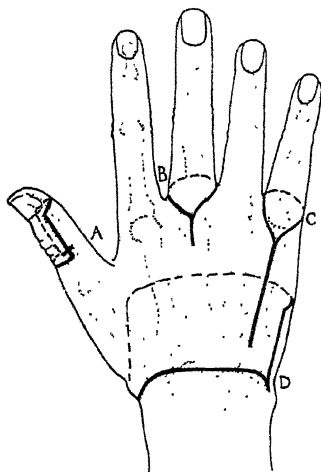


Fig. 157—Amputations of the fingers and hand; A, Amputation of part of the thumb by a long palmar flap; B, Racket-shaped incision for amputation of a digit; C, The same, including the metacarpal bone; D, Amputation of the hand by a long palmar and short dorsal flap.

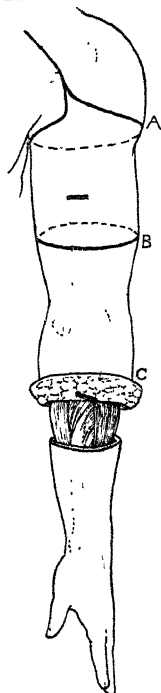


Fig. 158—Amputations of shoulder, arm, and forearm. A, Amputation at the shoulder by a racket-shaped incision; B, Amputation through the middle of the arm by a circular incision; C, Amputation through forearm by a circular incision.

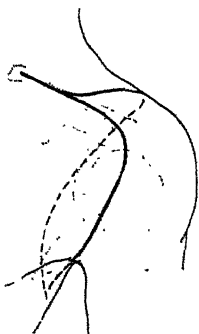


Fig. 159—Forequarter amputation by a racket-shaped incision.

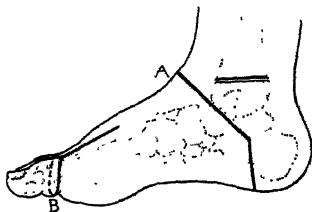


Fig. 160—Amputation of the toes and foot. A, Incision for Syme's amputation of the foot; B, Racket-shaped incision for amputation of a toe.

Forequarter Amputation, continued.

of the axilla (*Fig. 159*). Divide the clavicle at its inner third and retract the outer portion. Expose and ligature the sub-clavian artery and vein. Inject the brachial plexus with 2 per cent novocain. Turn back the skin flaps. Cut through the muscles attaching the arm to the chest.

Toes and Front of Foot.—

REMOVAL OF SEPARATE DIGITS is done by a *racket incision*, through the metatarso-phalangeal joint (*Fig. 160, B*).

REMOVAL OF ALL THE TOES is sometimes called for in cases of frost-bite.

LISFRANC'S AMPUTATION consists of making a *long plantar flap* with removal of all the metatarsals.

MIDTARSAL AND SUBASTRAGALOID AMPUTATIONS are seldom done, because of the loss of control of the bones forming the stump, which tend to become dislocated backwards.

Whole Foot.—Syme's amputation.

Two points are taken : (1) The tip of the external malleolus ; (2) A point one finger-breadth below and behind the tip of the internal malleolus. These are joined by two cuts down to the bone, one across the front of the ankle and the other below the heel. The foot is disarticulated in front at the ankle. The calcaneum is dissected out from the heel flap, dividing the tendo Achillis. The soft parts are turned up from the malleoli and the ends of the tibia and fibula cut off. (*Fig. 160, A*.)

Leg.—

AT SEAT OF ELECTION (i.e., 5 to 7 in. below the knee).—This is the operation of choice for all conditions requiring removal of the lower part of the leg. Many consider that it should supersede Syme's amputation because it is better suited for an artificial limb.

Formation of Flaps.—If there is ample healthy skin, the long external flap is best. Otherwise a long posterior flap or equal lateral flaps will serve. The combined flaps should exceed in length the diameter of the calf at the level of the bone section. *The external flap* should contain all the muscle down to the interosseous membrane, and round the fibula, and should include the anterior tibial artery. *The incision* for the external flap begins at the crest of the tibia about 6 in. distal to the tubercle, and ends in the middle of the calf at an opposite point. The inner part of the leg is divided by a slightly curved incision joining the beginning and end of the flap incision. (*Fig. 161, B*.)

The bones are divided about 5 to 7 in. distal to the tubercle of the tibia. The fibula should be divided first, obliquely from above downwards and inwards. The tibia is divided obliquely from above downwards and backwards, so as to cut off the sharp angle of the crest. (*Fig. 162*.)

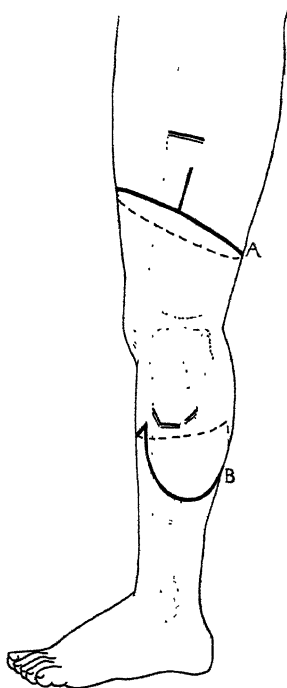


Fig. 161.—Amputations of the thigh and leg. A, Amputation through the lower part of the thigh by an elliptical incision; B, Amputation of the leg at the seat of election by a long external flap.

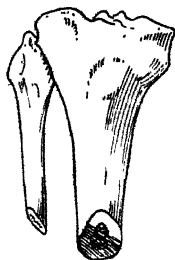


Fig. 162.—Showing how crest of tibia is bevelled off by an oblique cut.

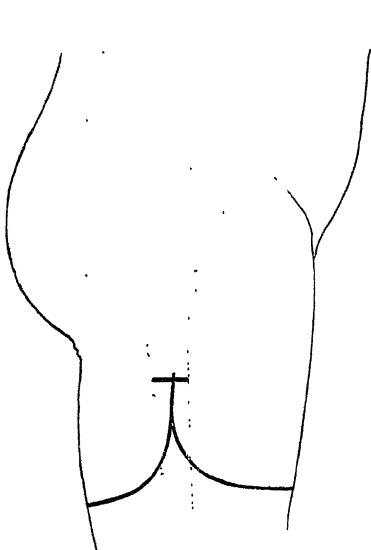


Fig. 163.—Amputation through the upper third of the thigh by equal flaps.

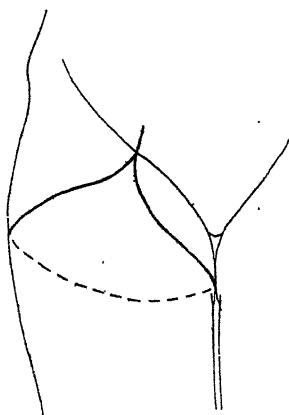


Fig. 164.—Amputation through the hip-joint by an anterior racket-shaped incision.

Amputation of Leg, *continued*.

NEAR THE KNEE-JOINT.—Performed if there is not enough healthy tissue to give a stump 5 in. long. It is well worth while preserving the stump below the knee even if it is only 3 in. In this case it is better to remove the fibula entirely.

Through the Knee-joint.—This is not done now, because the best amputation through the knee will never give such a good stump for an artificial limb as one done through the lower third of the thigh. The limb-maker must have room to provide a hinge joint at the correct knee level.

Through the Thigh.—

LOWER OR MIDDLE THIRD.—The lower or middle third for the level of the bone division is the site of choice.

A circular or elliptical incision is made, a cuff of skin and fat is turned up, and the muscles are divided at a higher level.

The bone is divided at a level more than half the diameter of the thigh above the skin incision. (*Fig. 161, A.*)

UPPER THIRD.—In the upper third of a muscular thigh, the use of *equal flaps* is more convenient. Each flap is rather more than half the diameter of the limb, and includes skin, subcutaneous tissue, and fascia. The muscles are divided by a circular incision rather below the level of the bone section. (*Fig. 163.*)

Through the Hip-joint.—

Anterior Racket-shaped Incision.—The handle of the racket is a vertical line midway between the anterior superior spine and the symphysis pubis. The circular part surrounds the thigh at the level of the ischial tuberosity (*Fig. 164*).

Hæmostasis.—The external iliac vessels are exposed, ligatured in two places, and divided. Pressure on the abdominal aorta at its point of bifurcation over the 4th lumbar vertebra controls bleeding from the other vessels.

Disarticulation.—The capsule of the joint is divided close to the acetabulum, the hip dislocated, and the muscles attached to the femur divided.

CHAPTER LIII.

SURFACE MARKINGS.**HEAD AND NECK.****BONY POINTS OF CRANIUM.—**

NASION.—Nasofrontal suture.

GLABELLA.—Eminence above nasion.

INION.—External occipital protuberance.

BREGMA.—Point where coronal and sagittal sutures meet. The middle of vertical line joining the two pre-auricular points.

LAMBDA.—Junction of lambdoid and sagittal sutures, $2\frac{1}{2}$ in. above and in front of inion.

PTERION.—Junction of frontal, parietal, sphenoid, and temporal bones, $1\frac{1}{2}$ in. above centre of zygoma.

SINUSES.—

SUPERIOR LONGITUDINAL.—From middle of glabella to inion ; linear in front, $\frac{3}{4}$ in. wide behind. Inclines to the right.

LATERAL AND SIGMOID.—Band $\frac{1}{2}$ in. wide from a point above inion to point $\frac{3}{4}$ in. behind external auditory meatus, curving so that the highest point of curve is $\frac{3}{4}$ in. above Reid's base-line.

MIDDLE MENINGEAL ARTERY.—

MAIN TRUNK AND ANTERIOR BRANCH.—From middle of zygoma to a point (pteron) $1\frac{1}{2}$ in. above middle of zygoma and $1\frac{1}{2}$ in. behind the external angular process of the frontal bone, then upwards and backwards at angle of 45° .

POSTERIOR BRANCH.—From the main trunk backwards one finger's breadth above the zygoma.

CEREBRAL HEMISPHERE.—From glabella to pterion, curving downwards and backwards, $\frac{1}{2}$ in. above orbital margin ; from pterion to zygoma, curving downwards and forwards ; along zygoma and line of lateral sinus to inion. Mesial border from inion to glabella.

FISSURE OF ROLANDO.—From point $\frac{1}{2}$ in. behind middle of line from nasion to inion, downwards and forwards for $3\frac{3}{4}$ in. at angle of $67\frac{1}{2}^\circ$ (three-quarters of right angle) ; (or) downwards and forwards to a point 2 in. above pre-auricular point.

FACE CENTRES.—Lower third of fissure of Rolando.

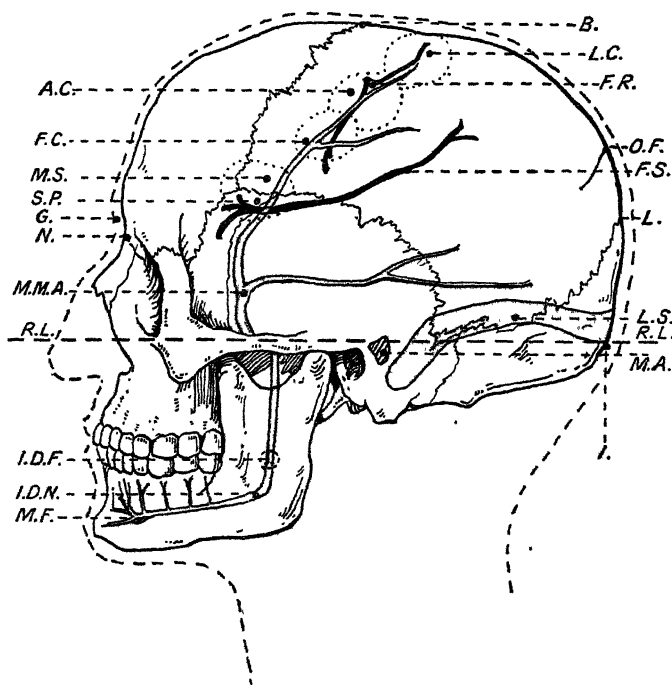
ARM CENTRES.—Middle third of fissure of Rolando.

LEG CENTRES.—Upper third of fissure of Rolando.

MOTOR SPEECH CENTRE (Broca's convolution).—Just above the left Sylvian point.

PLATE I.

HEAD.



B. Bregma; A.C. Arm centre; F.C. Face centre; M.S. Motor speech; G. Glabella; N. Nasion; M.M.A. Middle meningeal artery; R.L. Reid's line; I.D.F. Inferior dental foramen; I.D.N. Inferior dental nerve; M.F. Mental foramen; L.C. Leg centre; F.R. Fissure of Rolando; O.F. Occipito-parietal fissure; L. Lambda; F.S. Fissure of Sylvius; S.P. Sylvian point, pterion; L.S. Lateral sinus; I. Inion; M.A. Mastoid antrum.

Head and Neck, *continued*.

THE SYLVIAN POINT is $1\frac{1}{2}$ in. above the centre of the zygoma, and $1\frac{1}{2}$ in. behind the external angular process. It marks: (1) The pterion; (2) The middle meningeal artery; (3) The point of divergence of the anterior, ascending, and posterior limbs of the fissure of Sylvius; (4) The island of Reil; (5) The middle cerebral artery.

THE SYLVIAN FISSURE.—From the Sylvian point to a point $\frac{3}{4}$ in. below the parietal eminence.

THE OCCIPITO-PARIETAL FISSURE.—A line about $1\frac{1}{2}$ in. long drawn outwards towards the external angular process of the frontal bone from a point three-quarters of the way between the glabella andinion.

REID'S BASE-LINE.—From lower margin of orbit to the external auditory meatus and on toinion.

TREPHINE POINTS.—

LATERAL SINUS.— $\frac{3}{4}$ in. behind auditory meatus upon Reid's base-line.

MASTOID ANTRUM.—Suprameatal triangle, or point of junction of tangents drawn above and behind meatus.

TEMPOROSPHEOIDAL ABSCESS.— $\frac{3}{4}$ in. above post-auricular point.

CEREBELLAR ABSCESS.— $1\frac{1}{2}$ in. behind auditory meatus, 1 in. below Reid's base-line.

LATERAL VENTRICLE.— $1\frac{1}{2}$ in. above external auditory meatus.

SUPRA-ORBITAL NOTCH, INFRA-ORBITAL FORAMEN, AND MENTAL FORAMEN.—Line joining junction of middle and inner thirds of supra-orbital ridge to interval between two lower bicuspid teeth, crosses each of these.

INFERIOR DENTAL NERVE may be exposed by a trephine midway between the anterior and posterior margins of the ramus on the level of the alveolar border.

FACIAL NERVE.—Crosses ramus of the jaw level with the lower border of lobule of ear.

PAROTID DUCT.—From lower margin of tragus or concha to point midway between ala nasi and angle of mouth. Ends on margin of masseter opposite second upper molar.

CAROTID ARTERY.—From sternoclavicular joint to midway between angle of jaw and tip of mastoid.

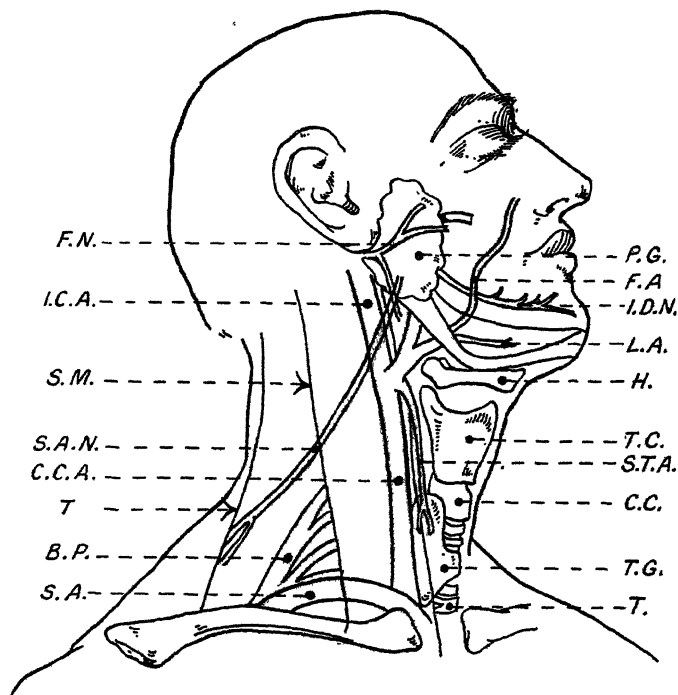
COMMON CAROTID.—Up to the upper border of the thyroid cartilage.

EXTERNAL CAROTID.—Same line above thyroid cartilage.

SUPERIOR THYROID ARTERY, LINGUAL ARTERY, AND FACIAL ARTERY.—Run downwards, forwards, and upwards respectively from a point on the external carotid opposite the great cornu of the hyoid bone.

PLATE II.

FACE AND NECK.



F.N. Facial nerve; I.C.A. Internal carotid; S.M. Sternomastoid; S.A.N. Spinal accessory nerve; C.C.A. Common carotid; T. Trapezius; B.P. Brachial plexus; P.G. Parotid gland; F.A. Facial artery; I.D.N. Inferior dental nerve; L.A. Lingual artery; H. Hyoid; T.C. Thyroid cartilage; S.T.A. Superior thyroid artery; C.C. Cricoid cartilage; T.G. Thyroid gland; S.A. Subclavian artery; T. Trachea.

Head and Neck, *continued*.

SUBCLAVIAN ARTERY.—Sternoclavicular joint to middle of clavicle. Forms a curve, which rises 1 in. above clavicle.

EXTERNAL JUGULAR VEIN.—From angle of jaw to middle of clavicle.

BRACHIAL PLEXUS.—Upper nerve from a point on the posterior border of the sternomastoid opposite the cricoid cartilage, to a point outside the middle of the clavicle. The lower nerve just above the clavicle.

SPINAL ACCESSORY NERVE.—From point between angle of jaw and mastoid to middle of posterior border of sternomastoid, then across posterior triangle to anterior border of trapezius.

UPPER BORDER OF THYROID CARTILAGE.—Level of disc between third and fourth cervical vertebræ.

CRICOID CARTILAGE.—Level of sixth cervical vertebra. Omo-hyoid crosses the carotid sheath. Beginning of œsophagus.

RIMA GLOTTIDIS.—Middle of the anterior border of the thyroid cartilage.

EPIGLOTTIS.—From below the thyroid notch to above the hyoid bone.

ISTHMUS OF THE THYROID GLAND.—A band $\frac{1}{2}$ in. wide, which is $\frac{1}{2}$ in. below the cricoid.

LATERAL LOBE OF THE THYROID extends up to the thyroid cartilage, down to the clavicle, and outwards to the carotid line.

THORACIC VISCERA, Etc.

SURFACE LINES.—Parasternal line is a vertical line midway between the edge of the sternum and the midclavicular line.

LUNGS.

APEX.—Extends 1 in. above inner third of clavicle.

MEDIAN BORDER.

Right.—Sternoclavicular joint to middle of manubrium, to sixth costal cartilage in mid-line.

Left.—Sternoclavicular joint to middle of manubrium, to fourth costal cartilage; along this to parasternal line; down this to sixth costal cartilage.

LOWER BORDER.—Sixth cartilage in parasternal line, to eighth rib in midaxillary line, to tenth rib in line of angle of scapula, to tenth dorsal spine (6-8-10).

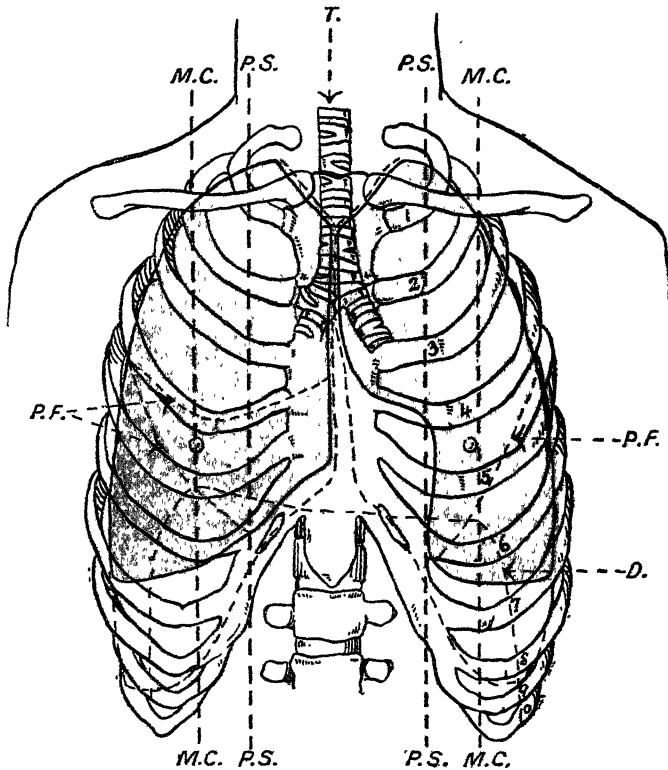
FISSURE.—Second dorsal spine downwards and forwards to sixth costal cartilage in parasternal line.

TRANSVERSE FISSURE (on the right side only).—From main fissure forwards along fourth rib and cartilage.

BIFURCATION OF TRACHEA.—In front—the angle between the manubrium and body of the sternum (angulus Ludovici). Behind—between third and fourth dorsal spines.

ROOT OF LUNGS.—Opposite fourth, fifth, and sixth dorsal spines.

PLATE III.
LUNGS AND PLEURÆ.



T. Trachea; P.S. Parasternal lines; M.C. Midclavicular lines; P.F. Pulmonary fissures; D. Diaphragm.

Purple = Lung. Blue = Pleura.

Thorax, *continued*.

PLEURA.—

APEX.—1 in. above inner third of clavicle.

MEDIAN BORDER.—

Right.—From mid-manubrium to seventh costal cartilage in mid-line.

Left.—From mid-manubrium to sixth costal cartilage to left of mid-line.

LOWER BORDER.—From lowest possible point of median border to 2 in. above tip of tenth costal cartilage, to twelfth rib, where it is crossed by erector spinæ, to twelfth dorsal spine; or more simply, seventh costal cartilage (parasternal) to ninth rib (midaxilla) to eleventh rib (scapula angle) (7-9-11).

HEART AND PERICARDIUM.—Lie between curved lines joining four points:—

1. Second left intercostal space, upper border, 1 in. from sternum
2. Second right intercostal space, lower border, $\frac{1}{2}$ in. from sternum.
3. Sixth right costosternal junction, 1 in. from sternum.
4. Fifth left interspace, $\frac{1}{2}$ in. inside mid-clavicular line.

RIGHT AURICULOVENTRICULAR GROOVE.—Joins 1 and 3.

VALVULAR ORIFICES.—All below and to the left of the line 1-3.

In order from above downwards:—

Pulmonary and Aortic.—Opposite third costal cartilage.

Mitral.—Opposite fourth costal cartilage.

Tricuspid.—Opposite fourth and fifth costal cartilages.

ASCENDING AORTA.—From third left to second right chondrosternal joint.

INNOMINATE ARTERY.—From middle of manubrium to right sternoclavicular joint.

FIRST PORTIONS OF LEFT SUBCLAVIAN AND LEFT CAROTID.—

From middle of manubrium to left sternoclavicular joint

PULMONARY ARTERY.—From third to second left chondrosternal junction.

LEFT INNOMINATE VEIN.—Left sternoclavicular joint to apex of the first right intercostal space.

RIGHT INNOMINATE VEIN.—Right sternoclavicular joint to apex of the first right intercostal space.

SUPERIOR VENA CAVA.—From first to the third right chondrosternal junction.

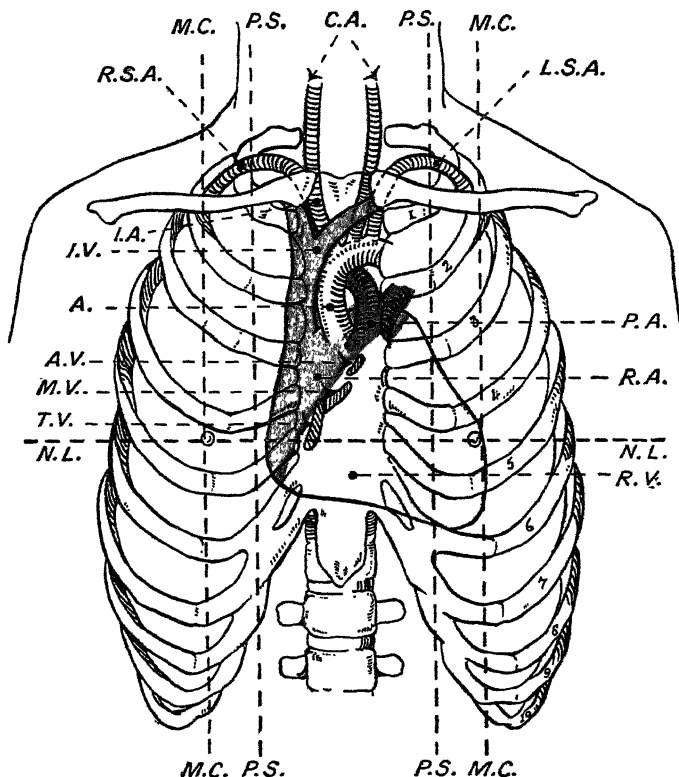
INTERNAL MAMMARY ARTERY.—From sternoclavicular joint vertically downwards to the sixth costal cartilage, $\frac{1}{2}$ in. from sternum above, but closer to it below.

MAMMARY GLAND.—Extends up to the second rib, down to the sixth, inward to the border of the sternum, and outward to the midaxillary line.

The nipple lies on the fourth rib, or interspace, on the midclavicular line.

PLATE IV.

HEART AND GREAT VESSELS.



C.A. Carotid arteries; P.S. Parasternal lines; M.C. Midclavicular lines; R.S.A. Right subclavian artery; L.S.A. Left subclavian artery; I.A. Innominate artery; I.V. Junction of right and left innominate veins to form superior vena cava; A. Aorta; P.A. Pulmonary artery; A.V. Aortic valve; R.A. Right auricle; M.V. Mitral valve; T.V. Tricuspid valve; N.L. Nipple line; R.V. Right ventricle.

Thorax, continued.

DIAPHRAGM—also highest level of liver (right), stomach (left).—

IN FRONT (5, 5, 5).—Fifth left interspace in midclavicular line, to junction of ensiform cartilage with sternum (fifth sternal joint), to fifth right rib in midclavicular line.

BEHIND (8, 8, 8).—Eighth rib in the right scapular line, to eighth spine, to eighth interspace in the left scapular line.

ABDOMEN.**SURFACE LINES.**—

TRANSPYLORIC PLANE, OR PYLORIC LINE.—Horizontal plane midway between upper border of sternum and crest of pubes, and midway between ensiform cartilage and navel. In normal parts it is also line joining tips of ninth costal cartilage.

It is the level of the following: Pylorus—first part of the duodenum. Gall-bladder. Duodenojejunal junction. Hila of kidneys—beginning of ureters. Body of pancreas. Beginning of mesentery. Lower border of first lumbar vertebra.

SUBCOSTAL PLANE.—Drawn through tips of the 10th ribs. Is on level with third lumbar vertebra.

LINE OF ILIAC CRESTS.—Level with fourth lumbar vertebra.

INTERTUBERCULAR PLANE.—Through the tubercles on outer lips of the iliac crests. Level with fifth lumbar vertebra.

MID-POUPART LINE.—Vertical line drawn through mid-point of Poupart's ligament.

LINEA SEMILUNARIS.—From tip of the ninth costal cartilage to a point midway between the anterior iliac spine and the umbilicus, and thence to the pubic spine.

LINEÆ TRANSVERSÆ.—(1) At umbilicus; (2) Midway between umbilicus and xiphoid cartilage; (3) At xiphoid cartilage.

INTERNAL ABDOMINAL RING.—Just above middle of Poupart's ligament.

EXTERNAL ABDOMINAL RING.—Just above the pubic crest.

LIVER.—

ABOVE IN FRONT.—From left fifth interspace in midclavicular line, to junction between sternum and ensiform cartilage, to fifth rib in the right midclavicular line.

BEHIND.—From eighth interspace in left scapular line, to eighth dorsal spine, to eighth rib in right scapular line.

BELOW.—From left fifth interspace in midclavicular line, to transpyloric plane in mid-line, to right costal margin.

STOMACH.—

CARDIAC ORIFICE.—1 in. to left of junction of ensiform cartilage.

PYLORIC ORIFICE.—1 in. to right of middle of transpyloric line.

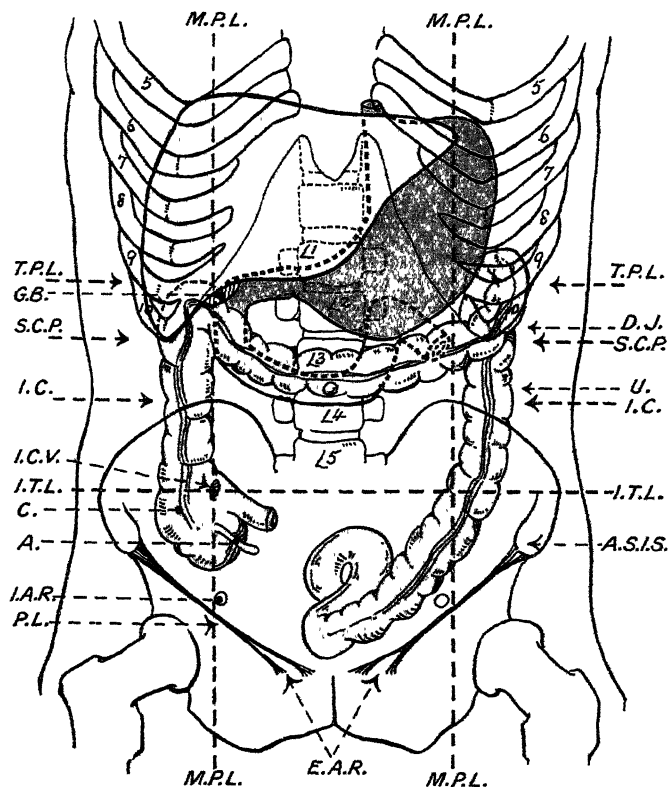
HIGHEST LEVEL.—Fifth interspace in left mid-clavicular line.

LOWEST LEVEL.—Infracostal line.

DUODENUM.—Begins 1 in. to right of middle of transpyloric line.

Ends 1 in. to left of middle of transpyloric line and a little below it. Extends to the right as far as right mid-Poupart line. Extends below as far as line joining highest points of the iliac crests.

PLATE V.
ABDOMEN FROM FRONT.



M.P.L. Mid-Poupart lines; T.P.L. Transpyloric line; G.B. Gall-bladder; D.J. Points to duodenojejunal junction; S.C.P. Subcostal plane; U. Points to umbilicus; I.C. Line of the iliac crests; I.C.V. Ileocaecal valve; I.T.L. Intertubercular line; C. Cecum; A. Appendix; A.S.I.S. Anterior superior iliac spine; I.A.R. Internal abdominal ring; P.L. Poupart's ligament; E.A.R. External abdominal ring.

Pink = Liver. Blue = Large intestine. Purple = Stomach.

Abdomen, continued.

MESENTERY.—From 1 in. to left of middle of transpyloric line and a little below it to a point midway along horizontal line between right anterior superior iliac spine and mid-line.

APPENDIX.—Attached end, midway along horizontal line between right anterior superior iliac spine and mid-line.

ILEOCÆCAL VALVE.—Point where right mid-Poupart line crosses intertubercular line.

CÆCUM.—In right iliac fossa below the intertubercular plane, one-third inside and two-thirds outside the mid-Poupart line.

COLON.

BOTH SIDES BEHIND.—Vertical line $\frac{1}{2}$ in. behind centre of iliac crest up to eleventh rib on the right side and to tenth rib on the left side.

ASCENDING COLON (in front).—From the intertubercular plane to the upper border of the ninth costal cartilage, lying outside but adjacent to the right mid-Poupart plane.

TRANSVERSE COLON (in front).—From the ninth right costal cartilage to the eighth left costal cartilage, where these are cut by the mid-Poupart plane. Curving downwards to the infracostal plane in the mid-line.

DESCENDING COLON (in front).—From eighth left costal cartilage to the left iliac crest, outside but adjacent to the mid-Poupart plane.

RECTUM (behind).—From a point 1 in. below the level of the posterior superior iliac spine (which is on a level with the second sacral spine) to the anus.

GALL-BLADDER.—At angle where ninth right costal cartilage is crossed by outer border of right rectus.

PANCREAS.

BODY lies on first lumbar vertebra, level of transpyloric line and of twelfth dorsal spine.

TAIL from twelfth dorsal spine to the left, up to the tenth rib above pyloric line.

HEAD lies below pyloric line level with second lumbar vertebra.

SPLEEN underlies ninth, tenth, and eleventh ribs on left side.

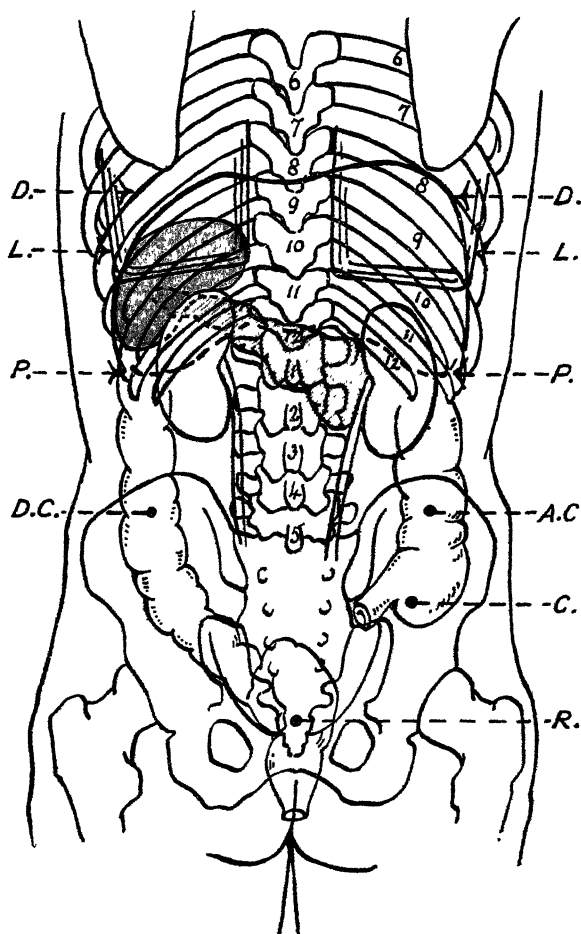
Innermost point $1\frac{1}{2}$ in. from tenth dorsal spine. Outermost point left maxillary line.

KIDNEYS.

BEHIND.—From the level of eleventh dorsal spine to that of third lumbar spine. Hilum 2 in. from first lumbar spine. Inner border 2 in. from mid-line, outer border 4 in. from mid-line.

IN FRONT.—Hilum is on transpyloric line 2 in. from middle line (tip of the ninth costal cartilage). Thence the kidney extends upwards 2 in. (to the sixth costal cartilage on the left and to the seventh on the right). Outwards 2 in. Downwards 2 in. to the infracostal plane on the left, and below this on the right. In each case the upper pole is $\frac{1}{2}$ in. nearer the mid-line than the lower. Left kidney is $\frac{1}{2}$ in. higher than right.

PLATE VI.
ABDOMEN FROM BEHIND.



D. Diaphragm ; L. Lowest level of lungs ; P. Lowest level of pleura ; D.C. Descending colon ; A.C. Ascending colon ; C. Cæcum ; R. Rectum.
Blue = Spleen, Pink = Kidneys and ureters. Shaded = Pancreas.

Abdomen, continued.

URETER.—From hilum to posterior superior iliac spine behind.
From hilum to bifurcation of iliac arteries in front.

SUPRARENAL CAPSULE.—Opposite inner part of eleventh intercostal space.

THE BLOOD-VESSELS.—

ABDOMINAL AORTA.—A band 1 in. wide from the tip of the xiphoid cartilage to the line joining the highest points of the iliac crests. Lying to the left of the mid-line.

INFERIOR VENA CAVA.—A band 1 in. wide below and $1\frac{1}{2}$ in. wide above, from the line joining the highest points of the iliac crests to the apex of the fifth right intercostal space. Lying to the right of the mid-line. Perforates the diaphragm at its highest point opposite the eighth dorsal spine.

THE CELIAC AXIS AND SUPERIOR MESENTERIC ARTERIES arise just above the transpyloric plane.

THE RENAL ARTERIES arise just below the transpyloric plane.

THE INFERIOR MESENTERIC ARTERY arises just above the infracostal plane.

ILIAC ARTERY.—From the left of the middle of line joining highest iliac points to a point midway between the anterior superior iliac spine and the symphysis pubis.

Upper third=common iliac, lower two-thirds=external iliac.

DEEP EPIGASTRIC ARTERY.—From a point midway between the anterior superior iliac spine and the symphysis pubis, towards the umbilicus.

DEEP CIRCUMFLEX ILIAC ARTERY.—Just above the outer half of Poupart's ligament and round the iliac crest.

THE PORTAL VEIN

THE COMMON BILE-DUCT

THE HEPATIC ARTERY

THE FORAMEN OF WINSLOW

{ From a point 1 in. to the right of the middle of the transpyloric line upwards and a little to the right to the costal margin. The vein and bile-duct extend 2 in. below the point given; the vein to the left and the duct to the right.

THE SPINAL CORD extends down as far as the first lumbar spine behind, or the transpyloric line in front. The spinal dura mater extends down to $\frac{1}{2}$ in. below the posterior superior iliac spines.

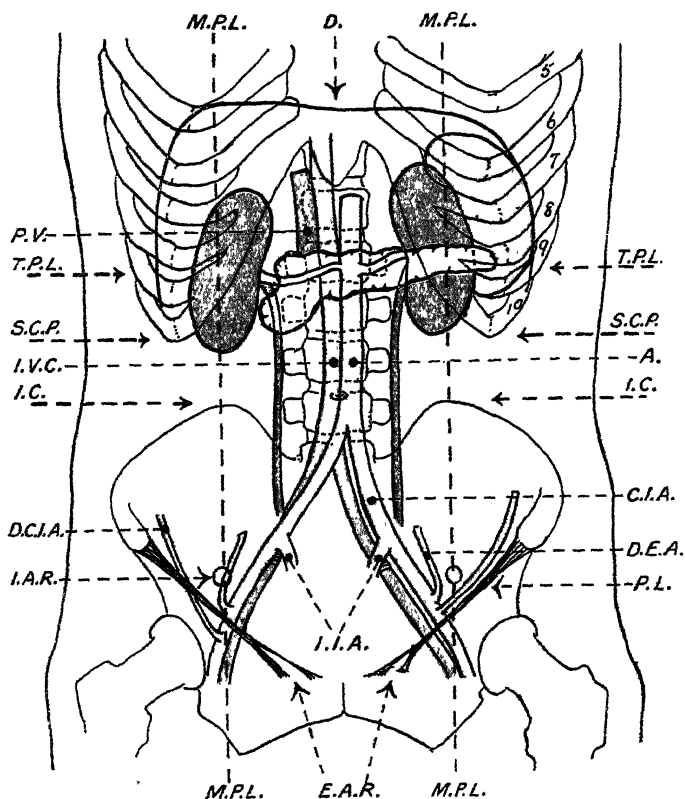
UPPER EXTREMITY.

ACROMIOCLAVICULAR JOINT.—Runs in a sagittal direction midway between the outer and inner borders of the arm when it is hanging at the side. It is just outside a bony tubercle on the anterior margin of the clavicle.

CORACOID PROCESS.—On the anterior deltoid margin, 1 in. below the junction of the middle and outer thirds of the clavicle.

PLATE VII.

DEEP ABDOMINAL VISCERA AND VESSELS FROM FRONT.



M.P.L. Mid-Poupart line; D. Diaphragm; P.V. Portal vein; T.P.L. Transpyloric line; S.C.P. Subcostal plane; I.V.C. Inferior vena cava; I.C. Line of the iliac crests; A. Aorta; C.I.A. Common iliac artery; D.C.I.A. Deep circumflex iliac artery; D.E.A. Deep epigastric artery; I.A.R. Internal abdominal ring; P.L. Poupart's ligament; I.I.A. Internal iliac artery; E.A.R. External abdominal ring.

Upper Extremity, continued.

BICIPITAL GROOVE.—A line 2 in. long downwards from the tip of the acromion in the long axis of the humerus.

TUBEROSITIES.—With the arm everted, the lesser tuberosity lies between the coracoid process and the bicipital groove. The great tuberosity lies outside the bicipital groove.

HEAD OF THE HUMERUS looks in the same direction as the internal epicondyle.

HUMERAL EPICONDYLES lie on the same level as the tip of the olecranon when the arm is extended.

RADIO-HUMERAL JOINT is $\frac{1}{2}$ in. below the tip of the external epicondyle.

ULNAR-HUMERAL JOINT is 1 in. below the tip of the internal epicondyle.

THE EXTERNAL INTERMUSCULAR SEPTUM extends from the insertion of the deltoid to the external epicondyle.

THE INTERNAL INTERMUSCULAR SEPTUM extends from the insertion of the coracobrachialis to the internal epicondyle.

AXILLARY AND BRACHIAL ARTERIES.—With the arm abducted and the hand supinated, the line from the centre of the clavicle to the point midway between the humeral condyles and 1 in. below them, represents the axillary and brachial arteries. A point one-third of the distance from the outer end of the anterior to the outer end of the posterior axillary folds is the end of the axillary and the beginning of the brachial.

THE RADIAL ARTERY.—From a point midway between the two epicondyles and 1 in. below them to the radial side of the tendon of the flexor carpi radialis. Thence under the tendons of the extensor ossis metacarpi pollicis and extensor brevis pollicis to the back of the first metacarpal space at its apex.

THE ULNAR ARTERY.—From a point midway between the epicondyles and 1 in. below them to the junction of the upper and middle thirds of a line drawn from the internal epicondyle to the radial side of the pisiform bone, and thence down this line.

THE SUPERFICIAL PALMAR ARCH is convex downwards and reaches to a level with the web of the thumb.

THE DEEP PALMAR ARCH is one finger's breadth above the superficial.

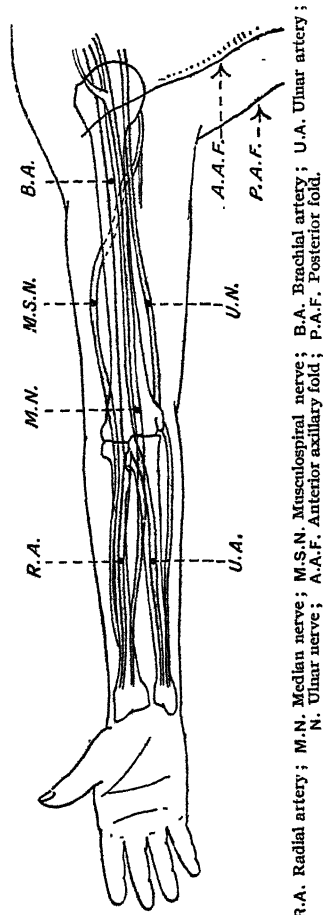
THE MEDIAN BASILIC AND MEDIAN CEPHALIC VEINS run from the centre of the antecubital space to the inner and outer borders of the belly of the biceps respectively.

THE BASILIC VEIN runs up the inner border of the biceps, and pierces the deep fascia rather more than halfway up the arm.

THE CEPHALIC VEIN runs up the outer border of the biceps, and then between the deltoid and pectoral muscles, and pierces the costocoracoid membrane.

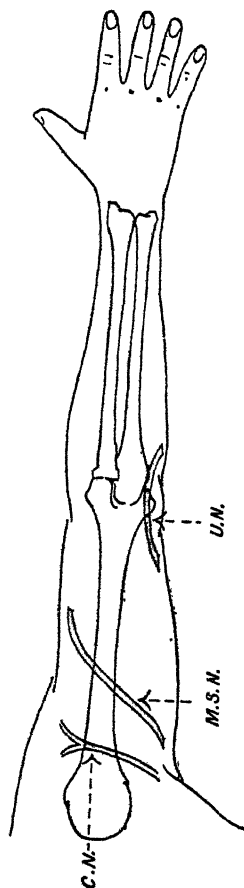
PLATE VIII.

ARM FROM FRONT.



R.A. Radial artery; M.N. Median nerve; M.S.N. Musculospiral nerve; B.A. Brachial artery; U.A. Ulnar artery;
N. Ulnar nerve; A.A.F. Anterior axillary fold; P.A.F. Posterior fold.

ARM FROM BEHIND.



C.N. Circumflex nerve; M.S.N. Musculospiral nerve; U.N. Ulnar nerve.

Upper Extremity, continued.

THE SUPERFICIAL LYMPHATICS run with the superficial veins, and end in trunks which accompany the basilic and cephalic veins.

THE LYMPHATIC GLANDS.—

1. AT THE BEND OF THE ELBOW—supratrochlear and antecubital glands draining the front of forearm and its inner side.
2. AXILLARY SET—lying with the axillary vein on the outer side of the axilla and draining forearm.
3. PECTORAL SET—along the outer margin of the pectoralis minor, and draining the chest wall and breast.
4. SUBSCAPULAR GROUP—along the posterior fold of the axilla, draining the back, the axilla, and part of the mammary gland.
5. SUBCLAVIAN GROUP—lying beneath both pectoral muscles below the clavicle, and running up under it to the posterior triangle of the neck. They receive the efferents from all the other groups.

THE CIRCUMFLEX NERVE (and posterior circumflex artery) passes round the back of the humerus just above the centre of the deltoid muscle.

MUSCULOSPIRAL NERVE (and superior profunda artery).—From the junction of the arm and posterior axillary fold to a point one-third of the way from the deltoid insertion to the external epicondyle, and thence in the groove between the biceps and supinator longus.

RADIAL NERVE.—From the groove between the biceps tendon and the supinator longus to the junction of the middle and lower thirds of the arm, when it passes beneath the supinator to the back of the wrist.

MEDIAN NERVE.—In the arm the same as the brachial artery; at the elbow it lies on its inner side; in the forearm it runs down to the wrist, when it passes beneath the anterior annular ligament to the ulnar side of the flexor carpi radialis.

ULNAR NERVE.—In the arm, at first with the brachial artery; then from the junction of the upper and middle thirds it runs to the groove behind the internal condyle, and thence to the radial side of the pisiform bone.

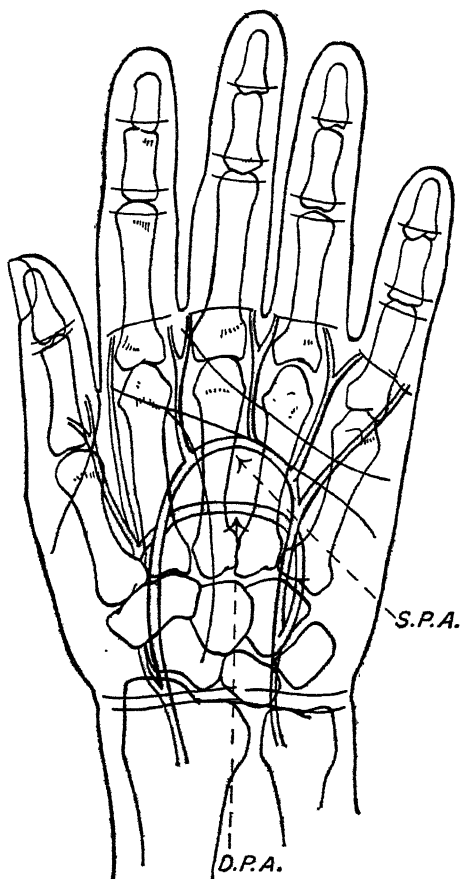
THE ELBOW-JOINT is one finger's breadth below the anterior skin crease.

THE WRIST-JOINT is indicated by the upper of the two skin creases in front.

THE TIP OF THE RADIAL STYLOID PROCESS is in the 'anatomical snuffbox', between the tendons of the flexores primi and secundi internodii pollicis. It is on a level with the lower wrist skin crease, $\frac{1}{2}$ in. below the wrist-joint.

PLATE IX.

HAND FROM FRONT.



D.P.A. Deep palmar arch ; S.P.A. Superficial palmar arch.

Upper Extremity, continued.

THE TIP OF THE ULNAR STYLOID is just below the level of the upper wrist skin crease, i.e., it is at $\frac{1}{2}$ in. higher level than the radial styloid.

THE TUBERCLE OF THE SCAPHOID is between the tendons of the flexor carpi radialis and the extensor ossis metacarpi pollicis on the lower wrist crease.

THE ANTERIOR ANNULAR LIGAMENT is 1 in. wide; its upper border corresponds to the lower wrist skin crease, and it stretches from the pisiform and unciform bones to the scaphoid and trapezium.

THE COMMON FLEXOR SYNOVIAL SHEATH (which includes the sublimis and profundus tendons and median nerve) extends two or three finger-breadths above the wrist-joint and below to the upper transverse palmar crease. It extends also into the little finger. The flexor longus pollicis has a separate sheath.

THE FLEXOR SHEATHS OF THE THREE MIDDLE FINGERS extend up as far as the lower palmar skin crease.

THE METACARPOPHALANGEAL JOINTS lie halfway between the lower palmar skin crease and the web of the fingers.

THE INTERPHALANGEAL JOINTS lie between the skin creases of the middle joint and opposite the crease of the lower.

THE TUBERCLE AT THE BACK OF THE RADIUS lies on the outer side of the sheath of the extensor secundi internodii pollicis.

THE TUBERCLE AT THE BACK OF THE CARPUS is the styloid process of the second metacarpal.

THE POSTERIOR ANNULAR LIGAMENT is 1 in. broad, and extends from the back of the radius to the interval between the ulna and the carpus.

THE SYNOVIAL SHEATHS AT THE BACK OF THE WRIST extend about 1 in. above and below the annular ligament. They are :—

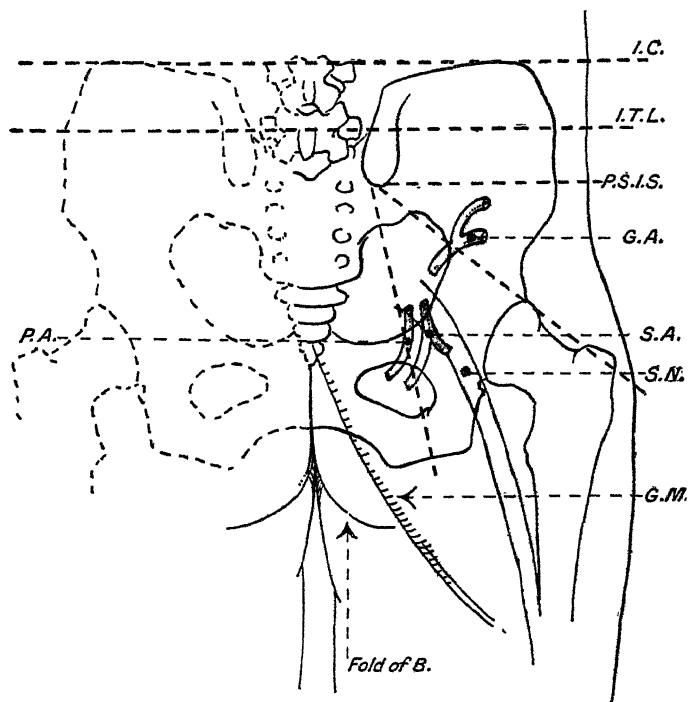
1. For the extensores ossis metacarpi and primi internodii pollicis.
2. For the extensores longus and brevis carpi radialis on the floor of the 'anatomical snuffbox.'
3. For the extensor secundi internodii pollicis on the ulnar side of the radial tubercle.
4. For the extensores indicis and communis digitorum behind the radius.
5. For the extensor minimi digiti between the radius and ulna.
6. For the extensor carpi ulnaris between the head and styloid process of the ulna.

LOWER EXTREMITY.

HIGHEST POINT OF ILIAC CREST.—On a level with the spine and body of fourth lumbar vertebra.

PLATE X.

GLUTEAL REGION.



I.C. Highest point of iliac crests; I.T.L. Level of iliac tubercles; P.S.I.S. Posterior superior iliac spine; G.A. Gluteal artery; S.A. Sciatic artery; P.A. Pudic artery; S.N. Sciatic nerve; G.M. Gluteus maximus; Fold of B. Fold of buttock. The two broken lines leading downward and outward from the posterior superior iliac spine indicate the surface markings for the gluteal and for the sciatic and pudic arteries.

Lower Extremity, continued.

TUBERCULAR POINT.— $2\frac{1}{2}$ in. behind the anterior superior spine. Level with fifth lumbar vertebra.

POSTERIOR SUPERIOR ILIAC SPINE.—Level with second sacral spine. Middle of sacro-iliac joint.

GREAT TROCHANTER.—Tip is crossed by Nélaton's line from anterior superior iliac spine to the ischial tuberosity. It is vertically below the tubercular point.

BRYANT'S TRIANGLE.—Patient lying horizontal. Draw a horizontal line up from tip of trochanter. Drop a perpendicular line from the anterior superior spine to meet the first line. Join the anterior superior to the tip of trochanter. Horizontal line shows the length of the femoral neck. Vertical line shows degree of rotation.

In the erect position tip of trochanter is vertically below tubercle on iliac crest.

SMALL TROCHANTER.—Is felt above the outer end of the gluteal fold when the femur is internally rotated.

LOWER BORDER OF THE GLUTEUS MAXIMUS.—Join junction of upper and middle thirds of the femur to the middle of the gluteal fold and produce upwards.

GLUTEAL ARTERY.—Leaves the pelvis at a point at the junction of the upper and middle thirds of a line joining the posterior superior spine to the tip of the great trochanter.

SCIATIC AND PUDIC VESSELS.—Leave the pelvis at a point at the junction of the middle and lower thirds of a line joining the posterior superior spine to the ischial tuberosity.

GREAT SCIATIC NERVE.—Vertical line midway between the great trochanter and the ischial tuberosity.

EXTERNAL INTERMUSCULAR SEPTUM OF THE THIGH.—Line joining the iliac tubercle to the head of the fibula.

TENDON OF THE BICEPS.—External hamstring.

TENDON OF THE SEMITENDINOSUS.—Internal hamstring.

TENDON OF THE SEMIMEMBRANOSUS.—Lies deep to the internal hamstring and then winds round underneath the inner head of the gastrocnemius; a bursa lying between the two tendons.

HIP-JOINT is marked by a circle inscribed in the following triangle: Vertical line dropped from the anterior superior spine, horizontal line drawn out from the pubic spine, Poupart's ligament.

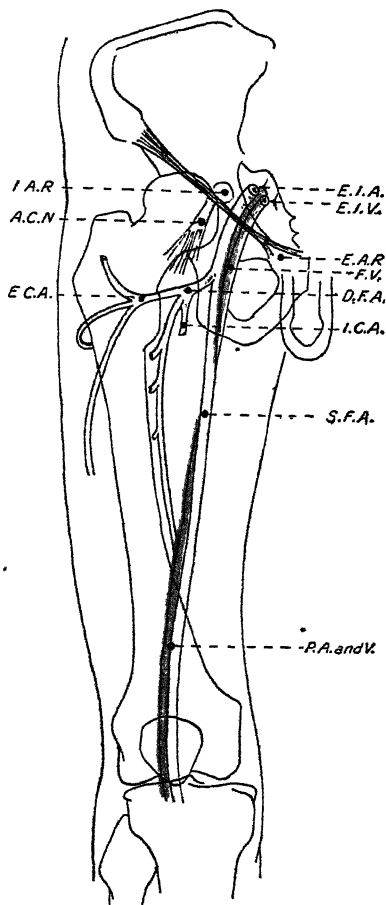
PUBIC SPINE is felt:—

In the male, by invagination of the scrotum into the external ring.

In the female, by following up the tendon of the adductor longus.

PLATE XI.

VESSELS AND NERVES OF THIGH.



E.I.A. External iliac artery; I.A.R. Internal abdominal ring; E.I.V. External iliac vein; A.C.N. Anterior crural nerve; E.A.R. External abdominal ring; F.V. Femoral vein; D.F.A. Deep femoral artery; E.C.A. External circumflex femoris artery; I.C.A. Internal circumflex femoris artery; S.F.A. Superficial femoral artery; P.A.V. Popliteal artery and vein.

Lower Extremity, continued.

SAPHENOUS OPENING.— $1\frac{1}{2}$ in. below and to the outer side of the pubic spine.

FEMORAL ARTERY.—Flex the hip and knee and rotate the thigh outwards. Join the mid-point between the anterior superior iliac spine and the symphysis pubis to the most prominent part of the internal condyle.

Upper two inches represent the common femoral, the rest the superficial. Upper third of line represents the artery in Scarpa's triangle. Middle third of line represents the artery in Hunter's canal. Lower third of line represents the popliteal artery in popliteal space.

POPLITEAL ARTERY BEHIND.—From apex of the popliteal space to midway between the two condyles at a point on a level with the tibial tubercle.

ANTERIOR TIBIAL ARTERY.—From a point midway between the head of the fibula and the external tibial tuberosity to a point midway between the malleoli, where it is crossed by the extensor longus hallucis.

DORSALIS PEDIS.—From midway between the malleoli to the base of the first metatarsal space. It is crossed by the inner tendon of the extensor brevis digitorum.

POSTERIOR TIBIAL.—From a point midway between the femoral condyles, but on a level with the tibial tubercle, down to a point one finger-breadth behind the inner malleolus.

INTERNAL PLANTAR ARTERY.—From the tip of the inner malleolus to the ball of the great toe.

EXTERNAL PLANTAR ARTERY.—From the tip of the inner malleolus to the base of the fifth metatarsal bone, and thence to the base of the first metatarsal cleft.

INTERNAL SAPHENOUS VEIN AND NERVE.—From in front of the inner ankle to the groove between the sartorius insertion and the inner head of the gastrocnemius, behind the inner condyle of the femur, and up to the saphenous opening.

EXTERNAL SAPHENOUS VEIN AND NERVE.—From behind the outer ankle to the middle of the popliteal space.

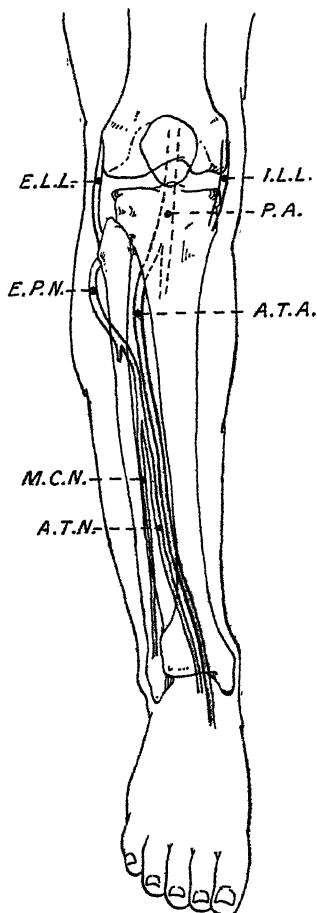
THE SUPERFICIAL LYMPHATICS follow the same line as the above two veins.

THE LYMPHATIC GLANDS.—

1. **POPLITEAL GROUP**—generally one or two, drain the outer side of the leg or foot.
2. **INGUINAL GROUP**—six to seven, parallel to Poupart's ligament, drain the anterior abdominal wall and upper part of the thigh.
3. **PUBIC SET**—two to three, over the pubis, drain the buttocks, anus, perineum, and external genitals.

PLATE XII.

VESSELS AND NERVES OF LEG.



E.L.L. External lateral ligament; I.L.L. Internal lateral ligament; P.A. Popliteal artery; E.P.N. External popliteal nerve; A.T.A. Anterior tibial artery; M.C.N. Musculocutaneous nerve; A.T.N. Anterior tibial nerve.

Lower Extremity, continued.

4. **SUPERFICIAL FEMORAL**—two to three, on the inner side of the femoral vessels at the saphenous opening, drain the greater part of the thigh and inner side of the leg and foot.
5. **DEEP FEMORAL**—one or two lie in the crural canal, and drain all the other superficial groups, together with the deep parts of the leg.

ANTERIOR CRURAL NERVE.—Downwards from a point midway between the anterior superior iliac spine and the spine of the pubes.

FEMORAL RING AND CRURAL CANAL.—Lie on the outer side of the pubic spine and on the inner side of the femoral vessels.

ADDUCTOR TUBERCLE.—Just above the most prominent part of the internal condyle. In the interval between the vastus internus in front and the sartorius behind. It marks the site of the epiphyseal junction.

KNEE-JOINT.—In full extension the lower border of the patella is on a level with the joint. In semiflexion a triangle exists in front of the inner side, bounded by the inner border of the patella, anterior lower border of the internal femoral condyle, and upper border of the internal tibial tuberosity. In this a displaced internal semilunar cartilage, or loose body, can be felt.

THE HEAD OF THE FIBULA is on the same level as the tubercle of the tibia.

INTERNAL LATERAL LIGAMENT OF THE KNEE.—From the most prominent point of the internal condyle to the inner surface of the inner tibial tuberosity.

EXTERNAL LATERAL LIGAMENT.—From the most prominent point of the external condyle to the tip of the head of the fibula.

EXTERNAL POPLITEAL NERVE.—Behind the tendon of the biceps. Winds forwards round the neck of the fibula.

POSTERIOR PERONEAL INTERMUSCULAR SEPTUM.—Line from the posterior border of the head of the fibula to the posterior border of the external malleolus. Indicates the line to cut down on the fibula.

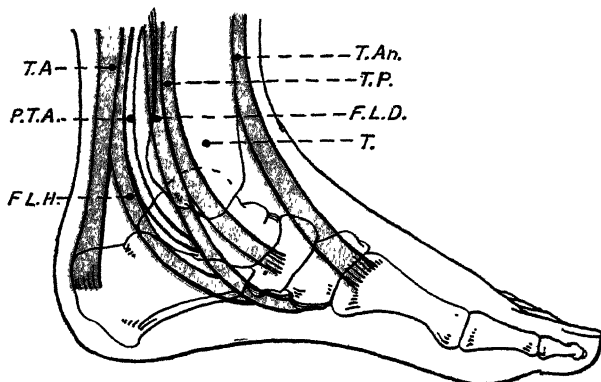
ANTERIOR PERONEAL INTERMUSCULAR SEPTUM.—Line from the anterior border of the head of the fibula to the anterior border of the external malleolus.

MUSCULOCUTANEOUS NERVE (cutaneous part).—Lower half of the above line.

ANKLE-JOINT AND MALLEOLI.—The joint lies $\frac{1}{2}$ in. above the tip of the internal malleolus and 1 in. above that of the external; the external malleolus being $\frac{1}{2}$ in. below and behind internal.

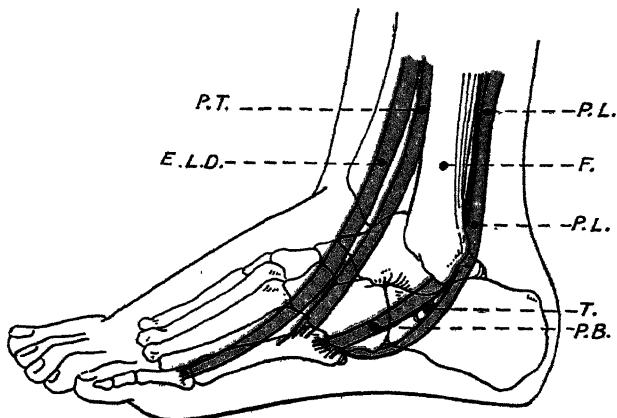
PLATE XIII.

FOOT FROM INNER ASPECT.



T.An. Tibialis anticus; T.A. Tendo Achillis; T.P. Tibialis posticus; P.T.A. Posterior tibial artery; F.L.D. Flexor longus digitorum; T. Tibia; F.L.H. Flexor longus hallucis.

FOOT FROM OUTER ASPECT.



P.T. Peroneus tertius; P.L. Peroneus longus; E.L.D. Extensor longus digitorum; F. Fibula; T. Peroneal tubercle; P.B. Tendon of peroneus brevis.

Lower Extremity, continued.

PERONEAL TUBERCLE.— $\frac{1}{2}$ in. below the tip of the external malleolus; the tendon of the peroneus brevis lies above this and that of the peroneus longus below. Each has a synovial sheath, which join above the tubercle, and thence run 1 in. above the outer ankle.

EXTENSOR BREVIS DIGITORUM lies in the interval between the tendons of the peroneus brevis and tertius.

HEADS OF THE ASTRAGALUS AND OS CALCIS are felt in the same interval.

THE HEAD OF THE ASTRAGALUS is also felt in the interval between the tibialis anticus and posticus tendons, and it ought to lie above the line joining the tip of the internal malleolus to the tubercle of the scaphoid.

SUSTENTACULUM TALI is $\frac{1}{2}$ in. below the tip of the internal malleolus. Between the two bony points run the tendons of the tibialis posticus and the flexor longus digitorum; below the sustentaculum runs the flexor longus hallucis.

TARSO-METATARSAL JOINT OF THE GREAT TOE is halfway between the metatarso-phalangeal joint and the tip of the inner malleolus.

THE TUBERCLE OF THE SCAPHOID is halfway between the tarso-metatarsal joint of the great toe and the inner malleolus.

THE ASTRAGALO-CALCANEAN JOINT on the inner side is just above the sustentaculum tali, and on the outer side midway between the tip of the external malleolus and the peroneal tubercle.

THE CALCaneo-CUBOID JOINT is midway between the peroneal tubercle and the base of the fifth metatarsal bone.

ANTERIOR ANNULAR LIGAMENT:—

1. **UPPER PART.**—A band two finger-breadths wide from the anterior margin of the tibia to that of the fibula at their lower ends. Has one synovial sheath, that for the tibialis anticus.
2. **LOWER PART.**—A Y-shaped band from the os calcis in front of the tip of the external malleolus up to the anterior border of the tibia and across to the inner margin of the instep. Has three synovial sheaths, for the tibialis anticus, extensor longus hallucis, and extensor communis with peroneus tertius.

INTERNAL ANNULAR LIGAMENT.—From the tip of the inner malleolus to the inner side of the posterior process of the os calcis. Has three synovial sheaths beneath it from within outwards for :
 (1) The tibialis posticus; (2) The flexor longus digitorum; (3) The flexor longus hallucis. All of these extend about 1 in. above the malleolus.

INDEX

The letters s.m. are abbreviations for 'Surface Markings'.

	PAGE		PAGE
ABBOTT'S method of treatment		Adductor tubercle, s.m.	666
— in scoliosis	188	Adenitis	155
Abdomen, contusions of	415	Adenoids	366
— wounds of	416	Adenoma (gen.)	73
Abdominal affections, acute	579	— of breast	408
— chronic	584	— kidney	570
— diagnosis of	579	— sebaceum	159
— symptom groups in	589	— of stomach	451
— aorta, s.m.	654	— thyroid gland	393, 394
— distension	585	Adrenalin in shock	100
— rings, s.m.	650	— with local anæsthesia	115
Abscess	7	Adventitious bursæ	184
— alveolar	359	Air embolism	148
— anatomy of	5, 6	Air-passages, foreign bodies in	395
— atheromatous	135	Albee's operation in Pott's disease	316, 317
— of bone, chronic	237	Alcohol injections in angina pectoris	177
— brain	331	— — gastric crisis of tabes	177
— otitic	352	— — trigeminal neuralgia	165
— breast	406, 407	Alopecia in syphilis	54
— Brodie's, of tibia	237	Alveolar abscess	359
— chronic	6	— sarcoma	71
— circumscribed renal	555	Amnesia due to head injury	335
— costal	7	Amœba coli	533, 534
— iliac	7	Amputations	634
— inguinal	47	— after-treatment	636
— intracranial	331	— for aneurysms	143
— otitic	352	— of arm	637, 638
— ischio-rectal	513	— in arthritis	73
— lacunar	47	— contused or lacerated wounds	81, 634
— of liver	532	— of fingers	636, 638
— lumbar	7	— foot	638, 639
— of lungs	401	— forearm	637
— pancreas	541	— forequarter	637, 638
— perineal	613	— for gangrene	24, 634
— perinephric	551	— guillotine	635
— post-pharyngeal	7, 381	— of hand	637, 638
— psoas	7, 313	— through hip-joint	640, 641
— retropharyngeal	7, 381	— indications	634
— of scalp	319	— through knee-joint	641
— spleen	546	— of leg	639, 640
— subcranial	328, 351	— Lisfranc's	639
— subphrenic	422	— of penis	610
— tropical, of liver	533	— for secondary hæmorrhage	129
— tuberculous	6, 7	— of shoulder	637, 638
— — of spine	313, 314	— site	635
Acapnia	96	— Syme's	638, 639
Accessory sinusitis	361, 364	— technique	635
Achondroplasia	246	— through thigh	640, 641
Acinous carcinoma	74	— of thumb	636, 638
Acid intoxication after anæsthesia	110	— toes	638, 639
Acromegaly	248	— tuberculous joints	279
Acromioclavicular joint, s.m.	654	— — hip	295
Actinomycosis	65	— — tarsal	298
— of liver	537	Amyloid disease	8

	PAGE		PAGE
Amyloid disease of liver	538	Ankylosis of ankle	298
Anæmia, pernicious, splenectomy in ..	546	— elbow	288
— splenic	546	— hip	291, 295
Anæsthesia (<i>see also</i> CHLOROFORM; ETHER)		— jaw	361
— after-treatment of	102	— joints	286
— choice of drug	113	— knee	297
— general, recent modifications of ..	102	— shoulder	288
— local	114	— in tuberculous joints ..	277, 291
— mortality rate of	115	— of wrist	289
— preparation of patient for ..	102	Annular ligament, s.m. ..	660, 668
— regional	111	Anorchism	617
— relation of shock to	116	Anterior poliomyelitis ..	163
— spinal	99	Anthrax	42
— — relation of shock to	117	— diagnosis from carbuncle ..	136
— splanchnic	99	— cedema	42
— syncope during	116	Antiperistalsis of colon ..	495
— treatment of emergencies ..	110	Antisepsis and asepsis ..	87
Anæsthetic mixtures	112	Antiseptics, special use of ..	94
— sequences	111	Antitetanic serum	41
Anal fissure	515	Antrum, maxillary, disease of ..	361
— fistula	513	Anuria, calculous	564
Anastomosis operations in cancer coli	511	Anus, diseases of	512
Anatomical snuffbox, s.m. ..	658	— epithelioma of	517
Anel's operation for aneurysm ..	142, 145	— fissure of	515
Aneurysm	136	— fistula of	513
— by anastomosis	152, 248	— new growths of	516
— arteriovenous	146	— pruritus of	523
— circumscribed traumatic ..	146	— syphilis of	516
— cirroid	152	Aorta, abdominal, s.m. ..	654
— compression of	142	'Ape hand' in median nerve paralysis	171, 172
— course and terminations of ..	140	Aphthous glossitis	70
— diagnosis of	141	Apicolysis	402
— diffuse traumatic	146	Appendices epiploicæ, morbid condi-	
— dissecting	145	— tions associated with	505
— effects of	139	Appendicitis	427
— fusiform	137	— clinical history of	430
— idiopathic	137	— diagnosis of	432
— leaking	140, 141	— etiology of	428
— ligature of artery in continuity in	143	— pathology of	428
— Matas' operation for	138, 142	— prognosis of	433
— modification of signs of ..	141	— relapsing	430
— rupture of	140	— treatment of	433
— sacculated	137, 140	— varieties of	432
— of scalp	338	— with peritonitis	430, 433
— spontaneous cure of	140	Appendicostomy in Hirschsprung's	
— suppuration of	140	— disease	498
— symptoms of	132	— intestinal obstruction ..	478
— traumatic	145	— ulcerative colitis	500
— treatment of	141	Appendix, anatomy of	428
— varicose	146	— s.m.	647
Aneurysmal varix	146	Arm, amputation of	637, 638
Angina, Ludwig's	31	— centres in cerebrum, s.m. ..	642
— pectoris, alcohol injections in ..	177	Arsenic in syphilis	60
Angioma	69	Arterial hæmorrhage	128
— of liver	538	Arteries, condition of, in shock	96
— plexiform	69, 152	— degeneration of	136
— of tongue	373	— diseases of	134
Aniline dyes as antiseptics	95	— ligature of, in continuity ..	143
Ankle, ankylosis of	298	— — gangrene following ..	23
— dislocations of	267	— rupture of	133
— and malleoli, s.m.	666	— wounds of	131
— stocking suspension for fractures		Arteriovenous aneurysm ..	146
— about	231	Arteritis, embolic	135
— tuberculous disease of	298	— septic	134
Ankyloglossia	369	— simple, plastic or traumatic	134

	PAGE		PAGE
Arteritis, varieties of	134	Bicipital groove, s.m.	656
Arthralgia, gonorrhoeal	48	Bier's congestive treatment in arthritis	272
Arthrectomy in tuberculous hip ..	294	— passive hyperæmia	3
— knee	297	Bile, stagnation of	525
Arthritis, acute	237, 271	Bile-duct, common, s.m.	654
— in children	274	Bile-ducts, calculi in	529, 531
— diagnosis from acute synovitis ..	269	— malignant growths of	539
— enteric	274	— rupture of	525
— gonorrhoeal	48	— wounds of	525
— gouty	273	Bilharzia papilloma of rectum ..	517
— of hip	290	Biliary fistula	531
— neuropathic	284	B.I.P.P. method in wounds	95
— pneumococcal	274	Bismuth compounds in syphilis ..	60
— pyæmic	273	Bites, insect and snake	83
— rheumatic	273	Black tongue	371
— syphilitic	280	Bladder, affections of	589
Arthroplasty in ankylosis	287	— atony of	599
Artificial pneumothorax, production of	401	— calculus of	594
Ascites	421	— carcinoma of	76, 592
— chylous	153	— diverticula of	597
Asepsis and antiseptics	87	— exstrophy of	589
Astragalo-calcaneal dislocation ..	268	— inflammation of	590
— joint, s.m.	668	— malignant ulcer of	592
Astragalus, dislocation of	267	— papilloma of	592
— s.m.	668	— paralysis of	598
Ateleiosis	344	— rupture of	589
Atheroma	135	— sounding of	589
Atony of bladder	599	— tuberculosis of	593
Auditory nerve, affections of ..	167	— tumours of	591
Avenolitis	473	Blood changes in inflammation ..	1
Avertin anæsthesia	115	— cysts	78, 249, 384
Axillary and brachial arteries, s.m. ..	656	— infections in gonorrhoea	49
		— picture in shock	96
		— transfusion	125
		— in shock	101
		— urea, estimation of	577
		Blood-pressure in shock	96, 98
		Blood-vessels (see also ARTERIES, VEINS)	
		— injuries to	121
		— subcutaneous	132
		— wounds of	131
		Bloxam's rhinoplastic operation ..	363
		Boils	157
		Bone-grafting in Pott's disease ..	316, 317
		— ununited fractures	211
		Bones, carcinoma of	76, 250
		— caries of	234
		— chronic abscess of	237
		— in congenital syphilis	57
		— cranial, tumours of	338
		— cysts of	252
		— diagnosis of swellings of	251
		— diseases of	233
		— fractures due to	201
		— fibrocystic disease of	246
		— gummata of	242
		— inflammatory diseases of	233
		— malignant growths of	76, 249, 253
		— myeloma of	249
		— necrosis of	234
		— new growths of	248
		— Paget's disease of	248
		— rickets	243
		— sarcoma of	249, 250, 252
		— sclerosis of	234
BACILLUS anthracis	9, 42		
— coli communis	4		
— pyocyaneus	5		
— tetani	9, 40		
— tuberculosis	9, 62		
— typhosus	5		
Bacteria, destruction of	91		
— exclusion from wounds	90		
— gastro-intestinal	91		
— in the intestines	495		
— pyogenic	4		
— various forms of	9		
Bacteriology of cystitis	590		
— peritonitis	417		
'Baker's' cysts	78, 184, 271		
Balanitis	47		
Balanoposthitis	47		
Baldness due to syphilis	54		
Balkan beam for fractured femur ..	224, 226		
Banti's disease	546		
Barker's operation for intussusception	456		
— solution	116		
— stoveaine solution	117		
Basilic vein, s.m.	656		
Bassini's operation for inguinal hernia	484		
Bechterew's (von) type of spondylitis			
— deformans	318		
Bed-sores	22		
Bee stings	83		
Bell's paralysis	170		
Bennett's fracture	220		
Biceps tendon, s.m.	662		

	PAGE		PAGE
Bones, skiagraphy of	253	Bursitis, malignant	183
— structure of	233	— plastic	183
— syphilis of	242	— septic	183
— syphilitic lesions of, tertiary ..	55	— serous	183
— tuberculous disease of	239	— simple	182
— tumours of	68	— syphilitic	183
— — causing fracture	203	— tuberculous	183
Bougies, method of passing	604	Butlin's operation for cancer of tongue	375
Bow legs	193		
Brachial and axillary arteries, s.m. ..	656		
— plexus, affections of	168		
— — s.m.	646		
Brain (<i>see also</i> CEREBRAL)			
— abscess of	331	CACHEXIA strumipriva	391
— — otitic	352	— Cæcal and colic volvulus	467
— compression of, diagnosis of .. 122,	332	Cæcum, s.m.	652
— — from head injury	326	— varieties of	494
— concussion of	325	Calcaneo-cuboid joint, s.m.	668
— — diagnosis of	122	Calcareous degeneration of arteries ..	136
— contusion of, resulting from head ..	326	Calculus anuria	564
— injury	342	Calculus in common duct	529, 532
— glioma of	342	— cystic duct	529, 532
— gumma of	56	— gall-bladder	529
— hernia of	341	— pancreatic	540
— lesions following head injuries ..	325	— prostatic	601
— — symptoms arising from	348	— renal	559
— protrusion through skull	341	— salivary	372, 377
— sarcoma of	342	— ureteral	574
— tumours of	76, 341	— vesical	594
Branchial cysts	77, 384	Caliper, Pearson's extension	226, 227
— tubulodermoids	384	— splint	224, 225
Brasdor's operation for aneurysm ..	142	Callus	204
Breast, abscess of	406, 407	Calmette's ophthalamo-reaction in ..	65
— adenoma of	408	Cancer (<i>see</i> CARCINOMA; EPITHELIOMA)	
— carcinoma of	76, 409	Cancerum oris	23
— colloid carcinoma of	412	Capillary hæmorrhage	130
— cysts of	407, 414	— nævi	152
— diseases of	406	— stasis in shock	96
— duct carcinoma of	409	Carbon dioxide, solid, for nævi	152
— — papilloma of	408	Carbuncle	156
— encephaloid carcinoma of	412	Carcinoma (<i>see also</i> EPITHELIOMA) ..	73
— inflammatory diseases of	406	— of bile-ducts	539
— sarcoma of	413	— bladder	592
— scirrhus of	73, 409, 414	— bones	76, 250
— — atrophic	412	— breast	73, 76, 409
— simple tumours of	408	— colloid, of breast	412
Bregma, s.m.	642	— colon	507
Broca's convolution, s.m.	642	— rectum	518
Brodie's abscess of tibia	237	— of colon	507
Bronchi, foreign bodies in	396	— — as a cause of obstruction	474
Bronchitis after anæsthesia	109	— columnar-celled	74
Brophy's operation for cleft palate ..	357, 358	— duct, of breast	409
Bruising	80	— encephaloid	74
Bryant's triangle, s.m.	662	— — of breast	412
Bubo, inguinal	47	— of gall-bladder	538
Bubonocoele	480	— jaw	360
Bullet wounds	82	— kidney	566, 567
Bullous rash in syphilis	53	— liver	538
Bunion	184	— lung	399
Burns	25	— œsophagus	383
— ulcer following	14	— pancreas	544
Bursæ, diseases of	182	— post-cricoid	397
Bursitis	182	— prostate	599
— fibroid	183	— rectum	73, 76, 517
— gonorrhœal	49	— — resection of presacral nerves in ..	177
— gouty	183	— salivary glands	378
		— sebaceous	74, 159

	PAGE		PAGE
Carcinoma of skull	338	Cervical cellulitis	31
— spheroidal-celled	74	— rib	169
— of stomach	451	Chance's splint for kyphosis ..	188
— relation to ulcer	450, 453	Chancre, hard or Hunterian ..	51
— testis	628	— of lip	353
— thyroid gland	394	— mixed	52
— tongue	76, 373	— relapsing	52
— treatment of	75	— soft	52
— uterus, radium treatment ..	76	Charcot's disease	284
— resection of presacral nerves in	177	— — diagnosis from chronic syno-	
Cardiac (<i>see also</i> HEART)		— vitis	270
— embolism	148	— intermittent fever	528
Cardiolysis	404	Chaufeur's fracture	219
Cardiospasm	382	Chest, surgery of	397
Caries of bones	234, 240	— wall, resection of, in empyema ..	401
— — syphilitic	55	Chimney-sweep's cancer	617
— sicca	240	Chloroform, administration of ..	106
— spinal	311	— after-effects	109
Carotid artery, s.m.	628	— causes of death under	108
Carpals, fractures of	220	— comparison with ether	108
Carrel-Dakin method of antiseptis	94	Chloroma	71
Cartilage of knee, rupture of ..	265	'Choked disc' in brain lesions ..	342, 346
— tumour	68	Cholecystectomy, etc., for gall-stones	531
Cartilages in arthritis	272	Cholecystitis	525
— loose	68	— with gall-stones	529
— in osteo-arthritis	281	Cholecystography in diagnosis of	
— rickets	244	gall-stones	530
— tuberculous joints	276, 291	Cholesterosis	526
Caseation of tubercles	63	Chondroma	68
Castration in new growths ..	629	Chordee complicating gonorrhœa ..	47
— tuberculosis of testis	628	Chordotomy	318
Cataphoresis in cancer	76	Chorion-epithelioma	74
Catarrh as a pathological process	2	Choroiditis, syphilitic	54
Catarrhal colitis	499	Chromocystoscopy	570
— otitis	350	Chylous ascites	153
Catgut ligatures, sterilization of	93	Cicatrical stricture of gut	474
Catheterization in prostatic hyper-		Cicatriziation of tubercles	63
trophy	585	— wounds, process	84
Catheters, sterilization of	93	Circumcision	608, 609
Cauda equina, injuries of	174	Circumflex nerve, affections of	
Cavernous navi	152	— — s.m.	658
Cellulitis	30	Cirsoid aneurysm	152
— cervical	31	Clavicle, dislocation of	257
— of hand	32	— fractures of	212
— orbit	31	Claw-foot	192, 199
— pelvic	31	Cleft palate	353
— of scalp	31, 319	— — Brophy's operation	357, 358
Cellulo-cutaneous erysipelas ..	35	— — Davies-Colley's operation ..	356, 357
Cementome	360	— — Lane's operation	356, 357
Cephalalgia in cerebral localization	345	— — Langenbeck's operation ..	356, 357
— from head injuries	335	— — Smith's operation	356
— syphilitic	56	Clover's inhaler	104
Cephalhydrocele, traumatic	320	Club-foot (<i>see</i> TALIPES)	
Cephalic vein, s.m.	656	Club-hand	189
Cephalo-tetanus	41	Clutton's joints	280
Cerebellar abscess, otitic	352	Coagulation necrosis	1
— tumours	344	Cocaine anæsthesia	115, 117
Cerebellum, regions of, with focal		Coccyx, fractures of	221
symptoms	350	Cock's operation for urethral stricture	613
Cerebral (<i>see also</i> BRAIN)		Cœliac axis, s.m.	654
— embolism	148	Cohnheim's theory of malignancy ..	67
— hæmorrhage	333	Coley's fluid injections in sarcoma ..	71
— hemisphere, s.m.	642	Colic in acute abdominal affections..	580
— irritation after head injury ..	325	— and cæcal volvulus	467
— localization	345	— gall-stone	528
— sinuses, infective thrombosis of	330	— in intussusception	468

	PAGE		PAGE
Colic in renal calculus	561	Connective-tissue tumours, malignant	70
— ureteric calculus	574	Contraction due to scars	86
Colitis	498	— Dupuytren's	189
— catarrhal	499	— of fingers, congenital	189
— mucomembranous	499	— Volkmann's	180, 185
— polyposa	501	Contused wounds	81
— ulcerative	499	Contusions	80
Collapse	96	— of abdomen	415
Colles's fracture	218	— cerebral	326
— law	56	Coracoid process, s.m.	654
Colliquative necrosis	1	Corns	157
Colloid carcinoma	412, 507, 518	— 'Corona veneris'	53
Colloidal metals in cancer	76	Corrosive chemicals and gangrene	23
Colon, anatomy and physiology of	494	Costal abscess	7
— cancer of	474, 507	Courvoisier's law	530
— dilatation of, idiopathic	496	Cowperitis	47
— — — ganglionectomy in	176	Coxa valga	190
— diseases of	494	— vara	190, 192
— diverticula of	501	— — — diagnosis from congenital dis-	
— fistulae of	510	location of hip	263
— functional diseases of	496	Cranial bones, diseases of	338
— stenosis of	460	— complications of otitis media	351
— s.m.	652	— lesions, facial nerve and	166
— tuberculosis of	405	— vault, syphilis affecting	55
— ulcers of	499	Cranioctabes	243
Colopexy in prolapse of rectum	522	— in congenital syphilis	57
Colostomy in cancer of colon	510	Cranium (<i>see</i> SKULL)	
— ulcerative colitis	500	Cretinism	385
Colt's mechanism for aneurysm	143	Cricoid cartilage, s.m.	646
Colubrine poisoning	83	Criple's operation for cancer of tongue	375
Compression of brain, diagnosis	122, 332	Croft's apparatus for fractures	206
— — from head injury	326	Crucial ligaments of knee, rupture of	266
— fractures of spine	304	Crural nerve, anterior, injuries of	175
Concussion of brain	325	— — s.m.	666
— — diagnosis of	122	Crutch palsy	207
— spinal cord	305	Curvature of the spine	186
Condyliomata of anus	516	— — in Pott's disease	312
— genital	72	Cut throat	384
— syphilitic	53	Cutaneous reaction, von Pirquet's	65
Condy's fluid as an antiseptic	94	Cyst formation in goitre	387
Congenital abnormalities of the kidneys		Cystic duct, calculus in	529, 531
— and ureters	547	— hygroma	78
— — spleen	544	— — of neck	384
— — testes	617	Cysticercus cellulosa	79
— contraction of fingers	189	Cystitis	590
— cysts of neck	384	— complicating gonorrhoea	47
— dislocation of hip	255, 262	Cysto-adenoma of breast	414
— hydrocele	78, 619, 626	Cystoscopy in testing renal efficiency	577
— hypertrophic dilatation of colon	496	Cystotomy for calculi	596
— — — ganglionectomy in	176	— cystitis	591
— inguinal hernia	481	— epithelioma	593
— malformations of oesophagus	381	— papilloma	592
— — rectum	512	— retention of urine	599
— — tongue	369	Cysts (gen.)	78
— phimosi	615	— 'Baker's'	78, 184, 271
— stenosis of pylorus	438	— blood	78
— stricture of intestine	475	— of bone	249, 252
— syphilis	56	— brain	342
— — bones in	242	— branchial	77
— — facies of	61	— of breast	407
— — of joints	280	— dental	69, 360, 362
— — testis	625	— dermoid (<i>see also</i> DERMoids)	77
— — talipes	192, 194	— distension	78
— — umbilical hernia	487	— of epididymis	78
Conjunctivitis, gonorrhoeal	48	— glandular	78
Connective-tissue tumours	68	— hydatid	78

	PAGE		PAGE
Cysts, hydatid, of bone ..	249, 252	Diffuse traumatic aneurysm ..	149
— — liver ..	535	Dilatation of colon, idiopathic ..	496
— — lung ..	401	— — — gangliectomy in ..	176
— implantation ..	77	— of stomach ..	440
— of jaw ..	360, 362	Dislocations ..	255
— kidney ..	568	— anatomy of ..	256
— lingual ..	77	— of ankle ..	267
— lip ..	53	— astragalus ..	267
— lymphatic ..	70, 78	— clavicle ..	257
— of mouth ..	372	— elbow ..	260
— neck ..	384	— hip ..	261
— neural ..	78	— — congenital ..	249, 266
— of new growths ..	78	— jaw ..	257
— pancreas ..	543	— knee ..	265
— parasitic ..	78	— patella ..	264
— paravaginal ..	78	— penis ..	615
— paracanthotic ..	78	— radius ..	260
— parovarian ..	78	— shoulder ..	258
— peritoneal ..	78	— spine ..	305
— rectal ..	77	— subastragaloid ..	267
— retention ..	78	— of tendons ..	178
— — ranula ..	372, 378	— thumb ..	261
— of scalp ..	337	— traumatic ..	256
— sebaceous ..	159	— treatment of ..	256
— of spleen ..	546	— of wrist ..	261
— stomach ..	451	Dissecting aneurysm ..	145
— synovial ..	78	Distension, general abdominal ..	585
— of testis ..	78	Diverticulitis ..	501
— thyroglossal ..	77, 373, 384	— diagrammatic representation of ..	503
— of tongue ..	372	Diverticulum of bladder ..	599
— tubulo- ..	78	— of colon ..	501
— urachial ..	78	— false ..	463
— of vitello-intestinal duct ..	78	— hernia of ..	491
		— Meckel's ..	463
		— oesophageal ..	381
		— propulsion, of pharynx ..	381
D		Dorsalis pedis, s.m. ..	664
DACTYLITIS, strumous ..	240	Dressing in chronic simple ulcers ..	15
— — syphilitic ..	55	— dry ..	94
Dakin's solution for wounds ..	95	— sterilization of ..	88, 93
Davies-Colley's operation for ..	356, 357	Duct carcinoma of breast ..	409
palate ..	58	— papilloma of breast ..	407
Deafness in congenital syphilis ..	183	— thoracic, division of ..	153
Deal-runner's shoulder ..	74	Duodenal ulcer ..	450
Deciduoma malignum ..	186	— — test meal in ..	436, 450
Deformities ..	136	Duodeno-jejunal fossa, hernia into ..	464
Degeneration of arteries ..	179	Duodenum, s.m. ..	650
— muscles ..	360, 362	Dupuytren's contraction ..	189
Dental cysts ..	644	— fracture ..	231
— nerve, inferior, s.m. ..	77	— splint ..	231
Dermoids (gen.) ..	372	Dyes, aniline, as antiseptics ..	95
— of floor of mouth ..	399	Dyspeptic ulcers of tongue ..	371
— lung ..	384	Dyspnoea in goitre ..	389
— neck ..	77	Dystrophia adiposogenitalis ..	344
— ovarian ..	337		
— of scalp ..	75		
— sequestration ..	77		
— tubulo- ..	363		
Deviation of septum nasi ..	540		
Diabetes, pancreatic ..	136		
Diabetic endarteritis ..	21		
— gangrene ..	650		
Diaphragm, s.m. ..	464		
Diaphragmatic hernia ..	376		
Diathermy in cancer of tongue ..	113		
Diet after anaesthesia ..	245		
— in rickets ..	241		
Diffuse osteosclerosis ..			

E	
EAR, middle (see OTITIS MEDIA)	
Echondrosis ..	68
Ecchymosis ..	80
— in haemophilia ..	130
Echinococcus cysts (see also CYSTS,	
HYDATID) ..	78
Ecthyma in syphilis ..	53
Ectopia testis ..	618
— vesicae ..	589
Ectrodactylism ..	189

	PAGE		PAGE
Eczema of nipple	406	Epithelioma of tonsil	380
Eczematous ulcer	14	Epulis	359
Ehrlich's remedy for syphilis	60	Erb-Duchenne paralysis	112, 169
Elbow, diseases of	288	Erb's paralysis and anaesthesia	112
— dislocations of	260	Ergot in post-partum hæmorrhage	124
— mmer's	183	Ergotinine in shock	100
— S.M.	658	Erysipelas	34
Elephantiasis Arabum	153	— cellululo-cutaneous	35
Embolectomy	21, 149	— checking sarcomata	71
Emboli, varieties of	148	— facial	35
Embolic arteritis	135	— faucial	35
— gangrene	20	— scrotal	35
Embolism	147	Erythema migrans	370
— pulmonary, operation for	405	— in syphilis	53
Emphysema in chest wounds	398	Esmarch's bandage for aneurysm	142
Empyema	400	— operation for closure of jaw	362
Encephalocele	341	Estlander's operation for empyema	401
Encephaloid carcinoma	74	Ether, administration of	104
— of breast	412	— after-effects	109
Enchondromata	252	— comparison with chloroform	105
Endarteritis, diabetic	136	— intratracheal insufflation	115
— obliterans and deformans	134, 136	— intravenous method	114
— syphilitic	136	— rectal	114
— tuberculous	136	Ethyl chloride, administration of	103
Endocarditis, gonorrhœal	49	— — indications for	102
Endosteal sarcoma	249	— — spray	117
Endothelioma	71	Eucaïne anaesthesia	115
— of salivary glands	378	Ewing's sarcoma	249
Enostosis of skull	338	Exophthalmic goitre	392
Enteric arthritis	274	Exostoses	252
— intussusception	468	Extension apparatus for fractured femur	224, 225
— volvulus	467	Extensor brevis digitorum, S.M.	668
Enterocoele	490	Extravasation of urine	613
Enteroliths	473	Eye affections in syphilis	54, 57
Enuresis	597		
Epididymis, cysts of	78		
— hydrocele of	619, 626		
Epididymitis	623, 626		
— complicating gonorrhœa	47		
Epigastric artery, S.M.	654		
Epiglottis, S.M.	646		
Epilepsy, traumatic	336		
Epiphyses, separation of	202, 214, 223		
Epiphyseal cartilage in rickets	244		
Epiphysitis	235, 240, 241, 242		
Epiplocele	490		
Epiploxy for ascites	422		
Epispadias	615		
Epistaxis	368		
Epithelial odontome	69, 360		
— tumours	73		
Epithelioid cells in histology of tubercle	62		
Epithelioma (see also CARCINOMA)	72		
— of anus	517		
— chorion-	74		
— in chronic ulceration	14		
— of jaws	359		
— larynx	397		
— lip	76, 353		
— nipple	406		
— penis	609		
— — diagnosis from chancre	52		
— pharynx	381		
— scalp	337		
— scrotum	617		
— tongue	76, 373		
		FACE centres, S.M.	642
		— Facial artery, S.M.	644
		— erysipelas	35
		— nerve, affections of	166
		— — S.M.	644
		— paralysis	167
		— tic	167
		Facies of congenital syphilis	67
		— in shock	98
		Fæcal accumulation causing obstruction	477
		— fistulæ	508
		— vomiting	458
		Fat embolism	148
		— necrosis and pancreatitis	540
		— tumour	68, 72
		Fatty degeneration of arteries	136
		Faucial erysipelas	35
		Felon	32
		Femoral artery, S.M.	664
		— hernia	485
		— ring and crural canal, S.M.	666
		Femur, amputation through	640, 641
		— fracture of	221
		Fibro-adenoma of breast	408
		Fibroblasts and healing of wounds	84
		Fibrocartilage, semilunar, rupture of	265
		Fibrocystic disease of bones	246
		— — testis	628
		Fibroid bursitis	183

	PAGE		PAGE
Fibroma	69	Fractures of humerus	209, 213
— of scalp	337	— maxilla	211
— tongue	373	— of nasal bones	363
Fibula, fractures of	229	— patella	228
— s.m.	666	— pelvis	220
Filarial infections	153	— Pott's	230
Fingers, amputation of	636, 638	— of radius	216, 218, 219
— deformities of	189	— repair of	204
— operations on, anaesthesia for	116	— of ribs	212
— tenosynovitis of	32	— scapula	213
Fissure in ano	515	— signs and symptoms	203
— of Rolando, s.m.	642	— simple, treatment of	205
Fistula	10	— — — comparison of operative and non-operative	207
— in ano	513	— of skull	320
— biliary	532	— — base	323
— of colon	510	— — gunshot	320
— faecal	508	— — vault	321, 322
— pemle	47	— Smith's	219
— perineal	613	— of spine	302
— salivary	378	— spontaneous	201
Flat-foot	197	— sprains with	255
Flavine as an antiseptic	95	— and swellings connected with bones	251
Floating kidney	548	— of tibia	229
Fœtal rickets	245	— ulna	217, 219
— and scurvy rickets	202	— ununited	210
— syphilis	57	— varieties of	202
Foerster's operation	318	Fragilis osseum	201
Follicular odontome	68, 360, 362	Freezing methods for anaesthesia	117
— tonsillitis	378	Frontal sinus, mucocele of	365
Foot, amputation of	638, 639	Frost-bites	25
— deformities of	194	Function, localization in cerebral cortex	346
— and leg, gangrene of	28	Furuncle	157
— perforating ulcer of	16	Fusiform aneurysm	137
Foramen of Winslow, hernia into	465		
— s.m.	654		
Forearm, amputation of	637, 638		
Foreign bodies in air-passages	395		
— bronchi	395		
— causing intestinal obstruction	472		
— in lungs	399		
— nose	363, 395		
— oesophagus	382		
— at rima glottidis	395		
— in stomach	437		
— trachea	395		
Forequarter amputation	637, 638		
Formalin as an antiseptic	94		
Fractional test meals	435		
Fractures	201		
— of acetabulum	221		
— after-treatment	206		
— Bennett's	220		
— carpal, metacarpals, and phalanges	220		
— causes of	201		
— chauffeur's	219		
— of clavicle	212		
— coccyx	221		
— Colles'	218		
— comminuted, repair of	204, 209		
— complications of	203		
— during treatment	207		
— compound	208		
— Dupuytren's	231		
— of femur	221		
— fibula	229		
— greenstick	202		
		GALACTOCELE	407
		Gall-bladder, carcinoma of	538
		— infection of	527
		— inflammation of	525
		— neoplasms of	538
		— rupture of	525
		— s.m.	652
		— strawberry	526
		— wounds of	525
		Gall-stones	526
		— causing intestinal obstruction	473
		— colic due to	528
		— impaction of	531
		— jaundice due to	528
		Galyi in syphilis	60
		Ganglion	182
		— Gasserian, operations on, in tri- geminal neuralgia	165
		Ganglionectomy	176
		Gangrene	2, 18
		— amputation for	24, 634
		— diabetic	21
		— dry	18
		— embolic	20
		— following arterial ligation	23, 144
		— — frost-bite	25
		— gas	23
		— infective	20, 23
		— of leg and foot	28
		— localized	23

	PAGE		PAGE
Gangrene, moist	19	Gonorrhœal urethritis	45
— puerperal	21	Gouty arthritis	273
— Raynaud's	22	— bursitis	183
— — ganglionectomy in	176	Gowns for surgeons	7, 93
— senile	21	Grafting, ureteral	572
— signs of	18	Granulation in inflammation	1
— spreading	23	— tissue, formation of	84
— symptomatic	20	Graves' disease	392
— thermal	20	Grawitz's tumour	72, 567, 569
— thrombotic	21, 22	Groves' cradle splint	226, 227
— of tongue	370	Guillotine amputation	635
— traumatic	20, 22	Gum acacia infusion in hæmorrhage	125
— treatment of	24, 176	Gumma	52, 55
— varieties of	20	— of bone	55, 242
Gangrenous cholecystitis with gall-stones	528	— brain	56
Gas anæsthesia, administration of	103	— joints	280
— — indications for	102	— larynx	56
— gangrene	23	— liver	538
Gasserian ganglion, operations on, in trigeminal neuralgia	165	— pharynx	381
Gastrectomy in gastric cancer	455	— rectum	56, 516
Gastric (<i>see also</i> STOMACH)		— skin	55
— crises of tabes, operations on sym-		— thyroid gland	386
— pathetic in	177	— tongue	56, 372
— hæmorrhage	447	Gummatous ulcer	55
— ulcer	441	— — in congenital syphilis	57
— — acute	442	Gunshot fractures of skull	320
— — chronic	443	— wounds	82
— — complications of	446	— — of abdomen	416
— — perforation of	446		
— — relation to carcinoma	450, 453		
— — test meal in	435, 436, 445		
Gastro-enterostomy	449, 455		
Gastro-intestinal bacteria	91		
Gastrojejunostomy in gastric ulcer	446		
Gelatin injections for aneurysm	143		
Genital warts	53, 72		
Genu valgum	191		
— varum	193		
Giant cells in histology of tubercles	62		
Gies' (von) joints	280		
Gigantism	246		
Glabella, s.m.	642		
Glanders	43		
Gleet	45		
Glioma	69, 342		
Glossitis, acute parenchymatous	369		
— aphthous	370		
— superficial	370		
Glottis, œdema of	396		
— — in syphilis	54		
Gloves, sterilization of	93		
— use in surgery	90, 92		
Gluteal artery, s.m.	662		
— bursæ	184		
Gluteus maximus, s.m.	662		
Goltre, anæsthesia for	116		
— exophthalmic	392		
— simple or parenchymatous	387		
— — treatment	390		
— toxic	392		
Gonococcus	9, 44		
Gonorrhœa	44		
— complications of	47		
Gonorrhœal rheumatism	48		
		HÆMATEMESIS in gastric ulcer	442, 445, 447
		Hæmatocele	622
		Hæmatoma	80
		— of scalp	319
		Hæmaturia in malignant disease of	567
		— kidneys	562
		— renal calculus	550
		— — injuries	558
		— — tuberculosis	592
		— symptomless	546
		Hæmolytic jaundice	402
		Hæmopericardium	130
		Hæmophilia	285
		— of joints	268
		— — diagnosis from acute synovitis	398, 399
		Hæmoptysis in lung wounds	121
		Hæmorrhage	122
		— arrest of	635, 641
		— — in amputations	128
		— arterial	125
		— blood transfusion in	130
		— capillary	333
		— cerebral	121
		— circumstances modifying effect of	127
		— classification of	122
		— diagnosis of	333
		— extradural or subcranial	447
		— gastric	125
		— gum acacia infusion in	128
		— intermediate or reactionary	333
		— intracranial	334
		— — in new-born	334
		— intrameningeal	368
		— nasal	541
		— pancreatic	

	PAGE		PAGE
Hæmorrhage, parenchymatous	130	Hernia, umbilical	487
— primary	128	— ventral	488
— into peritoneal cavity	579	Hernial sac, hydrocele of	620
— saline infusion in	125	Herpes of lips	353
— secondary	128	— tongue	370
— spinal	305	Herpetic ulcers of tongue	371
— symptoms of	121	Hessing's splint for fractures	206
— in thoracic wounds	397	Hibbs' operation in Pott's disease	316, 317
— venous	129	Hip, amputation through	640, 641
Hæmorrhagic pancreatitis	541	— ankylosis of	285, 289
Hæmorrhoids	521	— arthritis of	290
Hæmothorax	398, 399, 402	— dislocation of	261
Hair affections in syphilis	54	— congenital	255, 262
Hallux rigidus or flexus	200	— osteo-arthritis of	295
— valgus	199	— S.M.	662
Hammer-finger	189	— synovitis of	290
Hammer-toe	200	— tuberculous disease of	290
Hand, amputation of	637, 638	Hirschsprung's disease	496
— deformities of	189	— ganglionectomy in	176
— infections of	32	Histamine in shock	96
Hands, surgeon's, preparation of	92	Histrionic spasm	167
Hare-lip	353	Hodgen's splint for fractured femur	224
Head injuries (<i>see also</i> SKULL)	319	Hodgkin's disease	155
— intracranial complications	325	Horns, method of growth	72
— — remote results	335	Horseshoe kidney	547
— S.M.	642	Hour-glass stomach	449
Headache in cerebral localization	345	Housemaid's knee	183
— from head injuries	335	Humerus, fractures of	213
— syphilitic	56	— S.M.	656
Healing of wounds	84	Hump-back	188
Heart failure under anæsthesia	112	Hunterian chancre	57
— massage of	403	Hunter's aneurysm operation	138, 142, 145
— S.M.	648	Hutchinson's teeth	58, 61
— wounds of	402	— tetrad	625
Hectic fever	37	Hydatid cysts	78
Hemiglossitis	370	— of bone	249, 252
Hemithyroidectomy for simple goitre	390	— liver	555
Hepatic artery, S.M.	654	— lung	401
Hereditary syphilis (<i>see</i> CONGENITAL SYPHILIS)		Hydrarthrosis, gonorrhoeal	48
Hernia	479	Hydrencephalocele	341
— anæsthesia for	116	Hydrocele	619, 626
— cerebri	341	— acute	621
— congenital	481	— bilocular	622
— diagnosis of	482, 630	— congenital	619, 621
— diaphragmatic	462	— and infantile	78, 619, 622
— of diverticulum	491	— of the cord	620, 622
— into duodeno-jejunal fossa	464	— encysted	620, 622
— femoral	485	— of epididymis	620, 622
— into foramen of Winslow	465	— hernial sac	620
— infantile	481	— infantile	78, 619, 622
— inflammation of	489	— of neck	78, 384
— inguinal	480	— testis	620, 622
— internal, obstruction due to	464	— vaginal, primary chronic	620
— intersigmoid	465	Hydrocephalus	78, 339
— interstitial	481	— external	341
— irreducible	488	Hydrogen peroxide as an antiseptic	94
— of linea alba	488	Hydronephrosis	555
— Littre's	491	Hydrophobia	42
— obstruction of	489	— diagnosis from tetanus	41
— pathological conditions of	488	Hygroma, cystic	78
— pericæcal	465	— of neck	384
— Richter's	490	Hyperæmia, active	3
— strangulated	489	— Bier's, in arthritis	272
— operation for relief of	493	— in inflammation	1
— taxis in	492	— passive	3
		Hyperkeratosis of tongue	371

	PAGE		PAGE
Hypernephroma	72, 567, 569	Intestinal obstruction, pressure from outside	746
Hyperparathyroidism, generalized osteitis fibrosa and	247	— special varieties of	462
Hyperpituitarism	342	— treatment of	463
Hyperthyroidism	386	— by volvulus	466
Hypochlorite of soda as an antiseptic	94	— stricture	474
Hypoglossal nerve, affections of	168	Intestine, cancer of	474, 506
Hypopituitarism	342	— embolism in	149
Hypospadias	615	— polypi of	476
Hypothyroidism	385	— small, stenosis of	460
Hysteria, diagnosis from nerve division	162	— volvulus of	466
		Intracranial complications of head injuries	325
I LEO-CÆCAL intussusception	468	— otitis media	351
— valve, s.m.	652	— hæmorrhage	333
Ileocolic intussusception	468	— in new-born	334
Ileosigmoidostomy in ulcerative colitis	501	— inflammation	328
Iliac abscess	7	— and compression, diagnosis	332
— artery, s.m.	654	— lesions	166
Iliaca-ileocolic intussusception	469	Intrameningeal hæmorrhage	334
Incised wounds	80	Intratracheal ether insufflation	115
— of blood-vessels	131	Intussusception	468
Incontinence of urine	597	— acute	470
Indigocarmine test for renal efficiency	576	— chronic	472
Infantile hydrocele	78, 619, 622	— of the dying	469
— inguinal hernia	481	— retrograde	469
— paralysis	163	— treatment of	472
— syphilis	57	— varieties of	468
Inflammation	1	Iodides in syphilis	59
— and degeneration of muscles	179	— and iodine in goitre	390
— evidences in bone disease	252	Iodine method of antiseptics	91
— intracranial	328	Iodoform as an antiseptic	94
Infra-orbital foramen, s.m.	644	Iritis, syphilitic	54
Ingrowing toe-nail	158	Irritation, cerebral, after head injury	325
Inguinal bubo and abscess	47	— ulcers of tongue	371
— hernia	480	Ischæmic paralysis	180, 185
Inguino-scrotal swellings	630	— diagnosis from nerve division	163
Ionion, s.m.	642	Ischiorectal abscess	513
Injection treatment of varicose veins	151		
Innominate artery, s.m.	648	J ACKSONIAN epilepsy	336
— veins, s.m.	648	— Jaundice due to gall-stones	528
Insanity, traumatic	336	— hæmolytic	546
Insect bites	83	Jaws, actinomycosis of	65
Instruments, sterilization of	88, 92	— closure of	361
Internal herniæ	464	— cysts of	360
— strangulation	462	— epithelioma of	359
Intersigmoid hernia	465	— epulis of	359
Intestinal hernia	482	— lower, dislocation of	257
— keratitis in congenital syphilis	57	— fracture of	211
— mastitis	407	— necrosis of	359
— nephritis	552	— phosphorus	359
Intertubercular plane, s.m.	650	— tumours of	360
Intestinal bacteria	495	Jejunostomy in gastric ulcer	446
— obstruction	456, 580	Joints, ankylosis of	286
— acute	457	— in tuberculous disease	277, 292
— chronic	459	— Charcot's	284
— becoming acute	460	— in congenital syphilis	57
— differential diagnosis of	460	— diagnosis of affections of	299
— by enteroliths	473	— diseases of	269
— faecal accumulation	477	— dislocations of	255
— foreign bodies	472	— hæmophilia of	285
— gall-stones	473	— inflammation of	269
— internal strangulation	462	— injuries of	254
— intussusception	468	— loose bodies in	285
— kinking	465	— physical examination of	300
— new growths	476, 509		

	PAGE		PAGE
Joints, sprains and strains of ..	254	Lactation carcinoma of breast ..	413
— syphilis of	280	Lacunar abscess	47
— tarsal, diseases of	298	Lambda, s.m.	642
— tuberculous disease of	274	Laminectomy in fracture-dislocation ..	303
Jugular vein, s.m.	646	— Pott's disease	317
		Lane's operation for cleft palate ..	356, 357
K E L O I D	86	Langenbeck's operation for cleft palate, ..	356, 357
Keratitis, interstitial, in congenital syphilis	57	Lardaceous disease	8
Kidney (<i>see also</i> RENAL)		Laryngeal nerve, recurrent, affections of	168
— adenoma of	570	Laryngitis, oedematous	396
— affections of	547	— tuberculous	396
— calculus of	559	Larynx, affections of	396
— carcinoma of	567	— epithelioma of	397
— congenital abnormalities of ..	547	— foreign bodies in	395
— cysts of	570	— papilloma of	397
— embolism in	149	— syphilis of	56, 396
— function tests	576	Lead treatment of cancer	76
— fusion of	547	Leaking aneurysm	140, 141
— horseshoe	547	Leg, amputation of	639, 640
— hypernephroma	566, 567, 568, 569	— centres, s.m.	642
— injuries of	549	— and foot, gangrene of	28
— large polycystic	570	— syphilitic ulcer of	12, 17
— malformations of	547	— varicose ulcer of	17
— malignant disease of	567	Legs, bow	193
— misplacements of	547	Leontiasis ossea	361
— movable	548	Leucocytes in histology of tubercles ..	62
— myosarcoma of	567	Leucocytosis to produce resistance to infection	90
— pelvis, tumours of	571	Leucokeratosis of tongue	370
— pyogenic infections of	551	Leucoplakia of tongue	370
— s.m.	636	Leukæmia	155
— sarcoma of	567	— splenectomy in	546
— tuberculosis of	557	Ligaments, crucial, of knee, rupture of ..	266
— tumours of	566	Ligature of arteries in continuity ..	143
— benign	570	— — gangrene following	23
— wounds of	550	Ligatures, sterilization of	88, 93
Kimpton's method of blood transfusion ..	126	Ligneous thyroiditis	387
Kinking of the gut	465	Linea alba, hernia of	488
Kirschner's wire for skeletal traction, ..	226, 227, 230	— semilunaris, s.m.	650
Klumpke's paralysis	169	Lineæ transversæ, s.m.	650
Knee, amputation through	641	Lingual artery, s.m.	644
— ankylosis of	297	— cysts	77
— dislocation of	265	Lipoma (gen.)	68
— joint, s.m.	666	— nasi	159
— rupture of cartilage and ligaments of	265	— of scalp	337
— synovitis of	296	— tongue	373
— tuberculous disease of	296	Lips, epithelioma of	76, 353
Knock-knee	191	— herpes of	353
Kocher's method in treatment of dislocated shoulder	259	— syphilis of	56, 353
— operation for cancer of tongue ..	375	— thick	353
Koch's tuberculin	64	— tuberculosis of	353
Krause's (Hartley), operation in tri- geminal neuralgia	165	— tumours of	354
Kummell's disease	304	— ulcers of	353
Kuster's operation for ureteral stricture ..	574	Lisfranc's amputation	639
Kyphosis	188	Litholapaxy, indications and method ..	596
		Lithotomy, lateral, indications and method ..	597
L A C E R A T E D	81	Littre's hernia	491
— — of blood-vessels	131	Liver, abscess of	532
Laceration, cerebral	328	— actinomycosis of	537
— of spinal cord	306	— adhesions complicating gastric ulcer ..	448
		— affections of	524
		— amyloid disease of	538
		— angioma of	538

	PAGE		PAGE
Liver, carcinoma of	538	Malignant peritonitis	421
— embolism in	149	— pustule	42
— hydatid cysts of	535	— tumours	67
— movable	537	— ulcers	11
— s.m.	650	— — of rectum	74
— sarcoma of	538	Malleoli and ankle-joint, s.m. ..	666
— solid enlargements of	537	Mallet-finger	189
— syphilis of	538	Mammary gland, s.m.	648
— wounds of	524	Marie-Strümpell type of spondylitis	
Lobar and lobular mastitis	407	— deformans	318
Localization, cerebral	345	Marine sponges, use in surgery ..	94
Lock-jaw	39, 361	Marriage of syphilitics	58
Loose bodies in joints	285	Marrow tumour	70
— — knee	266	Masks, use in surgery	91
— cartilages (of synovial origin) in		Massage in fractures	206
joints	68	— of heart	403
Lordosis	188	Mastitis, acute	406
Lorenz' operation for congenital dis-		— chronic	407
location of hip	263	— lobar	407
Ludwig's angina	31	— lobular or interstitial	407
Lumbar abscess	7	Mastoid antrum, s.m.	644
Lungs, abscess of	401	Mastoiditis, acute	351
— actinomycosis of	65	Matas' operation for aneurysm ..	142
— complications in, after anæsthesia ..	109	Maxilla, inferior, dislocation of ..	257
— embolism in	149, 405	— — fracture of	211
— foreign body in	399	Maxillary antrum, diseases of ..	361
— operations on	399	Mayo's operation for umbilical hernia	487
— s.m.	646	Meckel's diverticulum	463
— tuberculosis of	401	Median basilic and cephalic veins, s.m.	656
— tumours of	399	— nerve, affections of	171
— wounds of	398	— — s.m.	658
Lupoid ulceration in congenital syphilis	57	Mediastinum, tumours of	399
— — tertiary syphilis	55	Megacolon	496
Lupus erythematosus	158	— ganglionectomy in	176
— vulgaris	157	Megaloglossia	369
Lymph cysts	78	Melanoma	71
Lymphadenitis	153	Meningeal artery, s.m.	642
Lymphadenoma	155	— lipoma	68
Lymphangiomata	70, 153	Meningioma (psammoma or endo-	
— of tongue	309	thelioma)	72, 343
Lymphangitis	153	Meningitis	329
— of hand	32	— acute	329
Lymphatic cyst	70	— — septic	329
— obstruction	153	— chronic	330
— permeation	410	— otitic	351
Lymphatics of arm, s.m.	656	— primary idiopathic	329
— diseases of	153	— spinal	305
— of leg, s.m.	664	— syphilitic	330
Lymph-gland affections	153	Meningocele	309, 310, 341
Lymphosarcoma	71, 155	Meningomyelocele	309, 310
— of spleen	546	Mental changes after head injuries	325, 335
— tonsil	80	— foramen, s.m.	644
		Mercurial stomatitis	54, 370
		— ulcers of tongue	371
		Mercurochrome as a genito-urinary	
		antiseptic	95
		Mercury in syphilis	58
		Mesenteric arteries, s.m.	654
		Mesentery, s.m.	652
		Metacarpals, fractures of	220
		Metastasis of breast cancer	410
		Metatarsalgia	200
		Micro-organism theory of malignant	
		tumours	67
		Middle-ear disease (see OTITIS MEDIA)	
		Mid-Poupart line, s.m.	655
MACEWEN'S osteotomy for knock-			
knee	193		
Macrocheilia	353		
Macroductylism	189		
Macroglossia	369		
Madelung's deformity of wrist	189		
Main-en-griffe	171		
Malignant bursitis	183		
— connective-tissue tumour	70		
— disease attacking scars	86		
— embolism	148		
— œdema	23		

	PAGE		PAGE
Mikulicz' (von), disease.. ..	378	Neck, s.m.	642
Miner's elbow	183	— sympathetic nerve in, affections	168
Miosis, spinal	308	— of	168
Moles	77	Necrosis of bones	234
Molluscum contagiosum	139	— — syphilitic	35
— fibrosus	69	— — tuberculous	240
Monorchism	617	— — coagulation	1
Morison's operation for ascites	422	— colliquative	1
Morphia in prevention of shock	99	— of jaw	359
Morton's disease	200	— quiet	234
Motor centres	346	— syphilitic	56
— speech centre, s.m.	642	Necrotic ulcers	11
Mouth, cancer of	76, 373	Neokharsvian in syphilis	60
— inability to open	40, 361	Neosalvarsan in syphilis	60
— mucous membrane of, in syphilis.. ..	54	Nephrectomy for calculi	564
— tumours of floor of	342	— — hydronephrosis	557
Movable kidney	548	— — injuries of kidney	550, 551
— liver	537	— — malignant disease	568
— spleen	544	— — movable kidney	549
Mucocele of frontal sinus	365	— — pyonephrosis	557
— maxillary antrum	361	— — renal tuberculosis	559
Mucoid tumour.. ..	69	— — ureteral injuries	572, 573
Mucomembranous colitis	499	Nephritis, interstitial	552
Mucous membranes in syphilis	54	Nephrolithotomy	564
— polypi of nose	365	Nephropexy in movable kidney	549, 557
Mummification	18	Nephrotomy for calculi	564
Mumps	377	— — pyonephrosis	557
Muscles, affections of	178	— — renal tuberculosis	559
— changes in, due to nerve division.. ..	160	Nerve, anterior crural	175
— inflammation and degeneration of	179	— auditory	167
— rupture of	178	— brachial plexus	168
— tumours of	182	— cauda equina	174
Musculocutaneous nerve, s.m.	666	— cervical rib compressing	169
Musculospiral nerve, affections of	170	— circumflex	170
— — s.m.	658	— — eleventh, or spinal accessory	168
— — paralysis	170	— — external popliteal	175
— — and anæsthesia	112	— — fourth	166
Myelitis from spinal injury	306	— — hypoglossal	168
Myelocele	309	— — internal popliteal	175
Myeloma.. ..	70, 249	— — laryngeal	168
— of jaw	360	— — median	171
Myoma	70	— — musculospiral	170
— of stomach	451	— — optic	166
Myosarcoma of kidney	567	— — phrenic	168
Myositis	179	— — posterior thoracic	170
— fibrosa	180	— — roots, posterior, resection of	318
— ossificans	179, 255	— — sciatic	174
— rheumatic	179	— — seventh, or facial	166
— suppurative	179	— — sixth	166
— syphilitic	179	— — sympathetic, in neck	168
— tuberculous	179	— — third	166
Myxœdema	385	— — trunks, blocking of, in prevention	
Myxoma	69	— of shock	100
		— ulnar	171
		— vagus	167
NÆVUS	69, 151	Nerves, affections of special	166
— — capillary	152	— — of deep sensation	161
— — cavernous	69, 152	— — division of	160
— — of hip	353	— — diagnosis of	162
— — scalp	337	— — epieritic	161
Nails, affections of	32, 158	— — injuries of	160
— — in syphilis	54	— — presacral, indications for resection	
Nasal (see Nose)		— of	177
Nasion, s.m.	642	— — protopathic	161
Neck, affections of	384	— — sympathetic, resection of	176
— cysts of	384	Nervous system, sympathetic	175

INDEX

685

	PAGE		PAGE
Papilloma of penis	616	Penis, dislocation of	615
— rectum	516	— epithelioma of	616
— scap	337	— malformations of	615
— skin	157	— papilloma of	616
— tongue	373	— tumours of	601
— villous	72	Perforating ulcer of foot	16
Papular rash in syphilis	53	Perforation in duodenal ulcer	451
Paralysis, Bell's	170	— gastric ulcer	446
— of bladder	598	Periarterial sympathectomy	15, 176
— brachial	168	Pericacal hernia	465
— crutch	207	Pericardial effusion	403
— Erb-Duchenne	112, 169	— suppuration	403
— facial	167	Pericardium, aspiration of	403
— infantile	163	— s.m.	648
— ischæmic	180, 185	Perichondritis, syphilitic	56
— — diagnosis from nerve division	163	Pericolicitis	498, 501
— Klumpke's	169	Peridiverticulitis	501
— of median nerve	171	— stricture due to	474
— musculospiral	112, 170	Perineal abscess	613
— posture, and anaesthesia	112	— fistula	613
— spastic, resection of posterior nerve roots in	318	Perinephric abscess	551
— of stomach	440	Perinephritis	551
— ulnar	171, 172, 174	Perionychia	158
Paralytic talipes	194	— in syphilis	54, 158
Paraphimosis	616	Periosteal lipoma	68
Paraplegia from Pott's disease	313, 318	— sarcoma	249, 250, 253
— from spinal injuries	306	Periostitis	234
Parasitic cysts	77	— of skull	338
— embolism	148	— syphilitic	55, 61
— myositis	179	— tuberculous	240
Parasternal line, s.m.	646	Peristalsis	495
Parathyroid glands	394	— visible and palpable	459
— — tumours of, generalized osteitis fibrosa and	247	Peritoneal bands	462
Paravaginal cysts	78	— cavity, hæmorrhage into	579
Parenchymatous glossitis	369	— — sudden invasion of	579
— goitre	387	— cysts	78
— hæmorrhage	130	— effusions, chronic	421
Parham's bands for fractures	227, 228	Peritonitis	416
Paronychia	32	— acute general	417
Paroöphoric cysts	78	— with appendicitis	430, 433
Parotid duct, s.m.	644	— bacteriology of	417
Parotitis	377	— chronic	419
Parovarian cysts	78	— diagnosis from intestinal obstruction	460
Parrot's nodes	242, 339	— local	418
— — in congenital syphilis	57	— malignant	421
Pasteur's treatment in hydrophobia	43	— pneumococcal	419
Patella, dislocation of	264	— tuberculous	420
— fractures of	228	Peritonitis	379
Patellar bursæ	184, 185	Permanganate of potash as an anti-septic	94
Pearson's extension caliper	227, 228	— — irrigation in gonorrhœa	45
— Peg-top' teeth in congenital syphilis	58	Pernicious anæmia, splenectomy in	546
Pelvic cellulitis	31	Peroneal tubercle, s.m.	668
Pelvis, fractures of	220	— muscular septum, s.m.	666
— in rickets	244	Peroxide of hydrogen as an antiseptic	94
Pemphigus, congenital syphilitic	57	Perthes' disease	246
— in syphilis	53	Pes cavus	192, 199
Penetrating wounds of abdomen	416	— planus	197
— — kidney	549	Phalanges, amputation of	636, 638
— — liver	524	— deformities of	189
— — lung	398	— fractures of	220
— — stomach	438	— syphilis affecting	55
Penile fistula	47	Pharyngeal pouch	381
Penis, amputation of	617	Pharyngitis	380
— diseases of	615	Pharynx, affections of	380

	PAGE		PAGE
Pharynx, epithelioma of	381	Prostatitis, acute and chronic	600
— stenosis of	381	— complicating gonorrhoea	47
— syphilis of	56, 381	— tuberculous	601
Phenolsulphonephthalein test in hydro- cephalus	340	Protargol as an antiseptic	94
— — for renal efficiency	577	Pruritus ani	523
Phimosis	615	Pseudocoxalgia	246
Phlebitis	149	Psoas abscess	7, 312
Phosphorus jaw	359	Psoriasis, syphilitic	53, 54
Phrenic nerve, affections of	168	Pterion, s.m.	642
— avulsion	402	Pubic spine, s.m.	662
Picric acid method of antiseptics	92	Pudic and sciatic vessels, s.m.	662
Piles	521	Puerperal gangrene	21
Pirquet's (von) cutaneous reaction	65	Pulmonary (<i>see also</i> LUNG)	
Pituitary body, functions of	344	— artery, s.m.	648
— extract in shock	100	— embolism	149
— tumours	344	— — operation for	405
Plantar arteries, s.m.	664	Pulsating tumours of scalp	337
Plates and bolts for fractures	227, 228	— — skull	338
Pleura, s.m.	648	Pulse in acute abdominal conditions	581
Pleurae, actinomycosis of	65	Punctured fractures of skull	321
Pleural effusion, chronic	400	— wounds	81
Plexiform angioma	69, 152	— — of blood-vessels	132
— neuroma	69	Pupil during chloroform anaesthesia	107
Pneumatocele	337	Pus, nature of	6
Pneumococcal arthritis	274	Pustular rash in syphilis	53
— empyema	400	Pustule, malignant	42
— peritonitis	419	Pyæmia	38
Pneumococcus	5	— gonorrhoeal	49
Pneumothorax, artificial	402	Pyæmic arthritis	273
— in lung wounds	399	— parotitis	377
Poisoning from snake bite	83	Pyelitis	553
— strychnine, diagnosis from tetanus	41	Pyelography	556
Poliomyelitis, anterior	163	Pyelonephritis	554
Polycystic kidney	570	— without suppuration	552
Polydactylism	189	Pylon used after amputations	636, 637
Polyorchism	617	Pyloric line, s.m.	650
Polypi, intestinal	476	— obstruction	448, 452
— multiple, of colon	501	— stenosis, congenital	438
— nasal	365	Pyogenic bacteria	4
— of rectum	516	— infections of kidney	553
Popliteal artery, s.m.	664	— ulcers	11
— nerve, s.m.	666	— suppuration in tuberculosis	63
— nerves, injuries of	175	Pyonephrosis	554
Portal vein, s.m.	654	Pyorrhoea alveolaris	359
Potassium permanganate, antiseptic	94		
— — irrigation in gonorrhoea	45	QUIET necrosis	234
Pott's disease	311	Quinine urethane injections	151
— fracture	230	Quinsy	379
— puffy tumour	328		
Presacral nerves, resection of, indica- tions	177	RABIES, diagnosis from tetanus	41
Prisapism	616	Radial artery, s.m.	556
Proctitis	512	— nerve, s.m.	558
— gonorrhoeal	48	— styloid process, s.m.	558
Profeta's law	56	Radiography of bones	253
Prolapse of rectum	522	Radio-humeral joint, s.m.	656
Proliferation in inflammation	1	Radiotherapy in exophthalmic goitre	403
Propulsion diverticulum of pharynx	381	Radium therapy in cancer	75
Prostate, carcinoma of	606	— — of tongue	376
— diseases of	600	Radius, dislocation of head of	260
— enlargement of	601	— fractures of	216, 218, 219
— inflammation of	600	Railway spine	304
Prostatectomy	605	Ramification	176
— in cancer of prostate	607	Rammstedt's operation for pyloric stenosis	439
Prostatic calculi	601		

	PAGE		PAGE
Ranula	372, 378	Rubber gloves, sterilization of	90, 93
Raynaud's disease	22	— use in surgery	90, 92
— ganglionectomy in	176	Rupia in syphilis	53
Recklinghausen's (von) disease	246	Rupture of an aneurysm	140
Rectal cysts	77	— arteries	133
— ether anaesthesia	114	— bladder	589
— injections in hæmorrhage	127	— crucial ligaments of knee	266
Rectum, carcinoma of	518	— gall-bladder or ducts	525
— — radium treatment	76	— muscles and tendons	178
— — resection of presacral nerves in	177	— semilunar fibrocartilage	265
— congenital malformations of	512	— spleen, subcutaneous	545
— diseases of	512	— urethra	608
— fibrous stricture of	515		
— inflammation of	515	SACCUATED aneurysm	137, 140
— malignant ulcer of	73	— Sacro-coccygeal tumours	311
— new growths of	516	Sacro-iliac joint, diseases of	289
— papilloma of	516	Saline infusion in hæmorrhage	125
— polypus of	516	— — shock	100
— prolapse of	522	— injection, hypertonic, in cerebral	
— results of excision of cancer	521	compression	325
— S.M.	652	— — — peritonitis	418
— sarcoma of	517	Salivary calculus	372, 377
— syphilis of	56, 516	— fistula	377
Reid's base-line, S.M.	644	— glands, affections of	377
Renal (<i>see also</i> KIDNEY)		— — tumours of	372, 378
— arteries, S.M.	654	— obstruction	377
— insufficiency	576	'Salmon patches' on cornea in con-	
Retained testis	617	genital syphilis	57
Retention cysts	78	Salvarsan in syphilis	60
— — of breast	407	Saphenous opening, S.M.	664
— — salivary glands	372, 378	— vein and nerves, S.M.	664
— — of urine	598	Sapremia	37
— — complicating gonorrhœa	47	Sarcoma (gen.)	70
— — in prostatic hypertrophy	604	— alveolar	71
Reticulum in histology of tubercles	62	— benign giant-cell	70
Retina, embolism in	148	— of bones	249, 253
Retinitis, gonorrhœal	48	— breast	413
— syphilitic	54	— Ewing's	249
Retropharyngeal abscess	380	— intracranial	342
— — chronic	7	— of jaw	360
Reverdin's skin-grafting	27	— kidney	567
Rheumatic arthritis	273	— liver	538
— myositis	179	— lung	399
Rheumatism, gonorrhœal	48	— lympho-	71
Rhinitis	364	— melanotic	71
— gonorrhœal	48	— of muscles	181
— purulent, in congenital syphilis	57	— periosteal	249, 250, 252
Rhinoplasty	363	— of rectum	517
Rhizotomy	318	— round-celled	70
Rib, cervical	169	— of salivary glands	378
Ribs, fractures of	212	— scalp	337
— resection of, in empyema	401	— skull	338, 342
Richer's hernia	490	— spindle-celled	71
Rickets	243	— of spleen	546
— fetal and scurvy, fractures in	202	— stomach	451
— — scurvy, and late	245	— testis	628
Riedel's disease of thyroid	387	— thyroid gland	394
— lobe	537	— tongue	373
Riggs' disease	359	— treatment of	71
Rima glottidis, foreign bodies at	395	Sarcomatous polypi of nose	366
— — S.M.	646	Scalds	25
Risus sardonius	40	Scalp, abscess or hæmatoma of	319
Rodent ulcer	73, 74	— aneurysm of	338
— — of scalp	337	— cellulitis of	31, 319
Rolando, fissure of, S.M.	642	— cysts of	337
Roseola in syphilis	53		

	PAGE		PAGE
Scalp, tumours of	337	Sinus and fistula	10
— wounds of	319	— frontal, mucocele of	365
Scaphoid, carpal, fractures of	220	— lateral, s.m.	642
— tubercle, s.m.	660, 668	— longitudinal, s.m.	642
Scapula, fractures of	213	Sinuses, thrombosis of	330
Scars, modification of	86	— — otitic	351
Schede's operation in empyema	401	Sinusitis, accessory	364
Schleich's infiltration anæsthesia	117	Skiagraphy of bones	253
Sciatic nerve, s.m.	662	Skin, affections of	156
— — injuries of	176	— eruptions in syphilis	53, 56
— and pudic vessels, s.m.	662	— reaction, von Pirquet's	65
Sciatica	176	— surfaces, preparation of, in surgery	88, 90, 91, 92
Scirrhus cancer	74	Skln-grafting	27
— — of breast	73, 409, 414	Skull, carcinoma of	338
— — — atrophic	412	— in congenital syphilis	57, 242
Sclerosis of bones	234	— enostosis of	338
Scolices	79	— fractures of	320
Scoliosis	186	— — base	323
Scorpion stings	83	— — gunshot	320
Scrofula erysipelas	35	— — nerve lesions with	166
— swellings	631	— — remote results of	335
Scrotum, epithelioma of	617	— — vault	321, 322
Scurvy rickets	245	— gumma of	242
— — causing fracture	202	— methods of opening	343
Sebaceous carcinoma	159, 741	— osteoma of	338
— cysts	159	— protrusion of brain through	341
— — of neck	484	— in rickets	244
— — scalp	337	— sarcoma of	336
— glands, affections of	159	— s.m.	642
Semilunar fibrocartilage, rupture of	265	— tumours of	338
Semimembranosus, bursæ in relation to	184	— vault of, syphilis affecting	55
— tendon of, s.m.	662	Sleeves for surgeons	90, 92
Seminoma testis	628	Sloughing	2
Semitendinosus, tendon of, s.m.	662	Smith's fracture	219
Senile gangrene	21	— operation for cleft palate	356
Septic arteritis	134	Smoker's patch	371
— bursitis	188	'Snail-track' ulcers in syphilis	54
— infection	36	Snake bites	83
— meningitis, acute	329	Snap-finger	189
— osteomyelitis	236	'Snuffles' in congenital syphilis	57
Septicæmia	37	Sodium morrhuate or salicylate injections in varicose veins	151
— gonorrhœal	49	— permanganate as an antiseptic	94
Septum nasi, deviation of	363	Spasm, hystrionic	167
— — obstruction due to	367	— of cesophagus	382
Sera, antibacterial and antitoxic	89	Spasmodic wry neck	168, 186
Serous bursitis	183	Speech centres, motor	346
Serum therapy in gonorrhœa	49	— — s.m.	642
— — tetanus	41	Spermatic cord, torsion of	618
Shell wounds	82	Spermatocytoma	628
Shock	96	Spica, plaster, for fractured femur	221, 222
— diagnosis of	122	Spina bifida	309
— due to burns	26	— — occulta	309
— — acute intestinal obstruction	457	Spinal accessory nerve, s.m.	646
— prevention of	99	— — affections of	168
— treatment of	100	— — anæsthesia	117
Shoulder, amputation through	637, 638	— — relation of shock to	98
— — deal-runner's	183	— — cord, concussion of	305
— — diseases of	288	— — injuries, diagnosis from nerve division	162
— — dislocations of	258	— — — diseases which result from	305
— — splint, abduction	214, 216	— — — laceration of	306
— — Sprengel's	188	— — — syphilis of	56
Sialography	377	— — — tumours of	308
Sigmoid volvulus	466		
Sigmoiditis, chronic	504		
Silver-salvarsan in syphilis	60		

	PAGE		PAGE
Spinal hæmorrhage	305	Stenosis of colon	460
— lesions at different levels	307	— pharynx	381
— total transverse	306	— pylorus, congenital	438
— meningitis	305	— small intestine	460
— miosis	308	Stercoraceous vomiting	458
— myelitis	306	Sterilization of instruments, etc.	92
— paraplegia	306	Still's disease	282
— tumours of	308	Stings of bees, wasps, scorpions	83
Spine, curvature of	186	Stocking suspension in ankle-joint fractures	231
— in Pott's disease	311	Stomach (<i>see also</i> GASTRIC)	
— rickets	244	— carcinoma of	451
— dislocations of	305	— — relation to ulcer	450, 453
— fractures of	302	— dilatation of	440
— railway	305	— diseases of	435
— resection of posterior nerve roots	318	— examination of	435
— tuberculous disease of	311	— foreign bodies in	437
Spinocain in spinal anæsthesia	118	— hour-glass	449
Spirochæta pallida	50	— injuries of	437
Splanchnic anæsthesia	116	— 'leather bottle'	452
Splay feet	198	— S.M.	650
Spleen, abscess of	546	— sarcoma of	451
— affections of	544	— simple tumours of	451
— congenital abnormalities of	544	Stomatitis, congenital syphilitic	57
— cysts of	546	— mercurial	54, 370
— effects of removal	544	Stone (<i>see</i> CALCULUS)	
— embolism in	149	Stovaine in spinal anæsthesia	117
— injuries of	545	Strains	254
— movable	544	Strangulated hernia	489
— S.M.	652	— — operation for relief of	493
— subcutaneous rupture of	545	Strangulation, internal, in causation of obstruction	462
— tubercle of	546	— intestinal, pathology	456
— tumours and enlargements of	546	Streptococcal glossitis	370
Splenectomy in various diseases	544	Streptothrix actinomycos	65
Splenic anæmia	546	Stricture, intestinal	474
Splint, abduction shoulder	214, 216	— of œsophagus	382
— Chance's, for kyphosis	188	— rectum, fibrous	515
— cock-up, for musculospiral paralysis	171, 172	— ureteral	573
— cradle, Groves'	227	— urethral (<i>see</i> URETHRA)	
— Dupuytren's	231	Strumous dactylitis	240
— for fractured tibia	230	Strümpell-Marie type of spondylitis deformans	318
— gallows	226, 227	Strychnine poisoning, diagnosis from tetanus	44
— Hessel's, for fractures	206	Sub-achilles bursa	181
— Hodgen's, for fractured femur	224	Subastragaloid dislocation	268
— for knock-knee	193	Subclavian artery, S.M.	646
— pressure, gangrene due to	22	Subcostal plane, S.M.	650
— for spinal caries	316	Subcranial abscess	328, 351
— Thomas's, for fractured femur	224, 225	— hæmorrhage	333
— — for tuberculous hip	292	Submaxillary cellulitis	30
— Todd's, for Colles's fracture	216, 219	Subphrenic abscess	422
— Verrall's, for ulnar and median lesions	173, 174	Sub-psoas bursa	184
— walking caliper	224, 225	Subsartorial bursa	184
Spondylitis deformans	318	Sulpharsenol in syphilis	60
Spondylolisthesis	188	Suppuration	2, 3
Sponges, use in surgery	94	— of an aneurysm	140
Sprains	254	— bacteria of	4
— diagnosis from acute synovitis	260	— of kidney	553
Sprengel's shoulder	188	— pericardial	403
Spring finger	189	— in tuberculosis	63
Squamous rash in syphilis	53	— wounds	84
Staphylococcal glossitis	370	Supra-orbital notch, S.M.	642
Staphylococcus	4	Suprarenal capsule, S.M.	652
Stasis of blood in inflammation	1	Surface markings	642
Status lymphaticus	108		
Steam, sterilization by	93		

	PAGE		PAGE
Surgeon's skin, preparation of ..	92	Syphilitic bursitis	183
Surgical instruments, sterilization of ..	92	— endarteritis	136
Suspension, stocking, for fracture about ankle-joint	233	— meningitis	330
Sustentaculum tali, s.m.	668	— myositis	179
Swabs, sterilization of	93	— and osteochondro-arthritis ..	280
Swellings connected with bones, diagnosis of	251	— osteosclerosis	242
— in inguino-scrotal region, diagnosis of ..	630	— synovitis	280
Sylvan point and fissure, s.m.	642	— thyroiditis	386
Syme's amputation	638, 639	— ulcers	12, 17
— for tuberculous tarsal joints ..	298	Syringomyelia	78
— operation for cancer of tongue ..	375	Syringomyelocele	309, 310
Symond's tube in stricture of the cesophagus	383		
Sympathectomy, peri-arterial ..	15, 176	T ABES, gastric crises of, operation on sympathetic for	177
Sympathetic nerve in neck, affections of	168	Tænia echinococcus	78
— nerves, resection of	175	Talipes	175, 194
Syncope	96, 101	— calcaneus	192, 197
— in anæsthesia	112	— congenital	192, 195
Syndactylism	189	— equinovarus	175, 192, 196
Synovial cysts	78	— equinus	192, 195
— sheaths at wrist, s.m.	660	— paralytic	194
— membrane in osteo-arthritis ..	280	— spastic	195
Synovitis, acute	269	— valgus	192, 197
— chronic	270	Talma's operation for ascites ..	422
— of elbow	288	Tannic acid treatment of burns ..	26
— hip	290	Tarsal joints, tuberculous disease of ..	298
— knee	296	Tarso-metatarsal joint of great toe, s.m.	668
— shoulder	288	Taxis for hernia	492
— syphilitic	280	Teeth in congenital syphilis ..	58, 61
— wrist	289	— tumours developing from ..	69
Syphilis	50	Temperature in acute abdominal conditions	580
— of anus	516	Tendon ligatures, sterilization of ..	93
— bones	55, 242, 252	— sheaths, diseases of	181
— congenital	56	— transplantation in musculospiral paralysis	171
— bones in	242, 252	Tendons, dislocation and rupture of ..	176
— facies of	61	Tenesmus in carcinoma coli ..	509
— of joints	280	Tenosynovitis	181
— eye affections in	54	— gonorrhæal	49
— fetal	57	— in the hand	32
— hair and nails in	54	Teratomata	77
— and hydrocephalus	340	— testis	628
— infantile	57	Test meals	434
— of joints	280	Testis, congenital abnormalities of ..	617
— larynx	56, 396	— cystic disease of	78
— lip	56, 353	— ectopia of	618
— liver	538	— hydrocele of	619, 626
— marriage in	58	— inflammation of	623
— mucous membranes of mouth and throat in	34	— new growths of	626, 628
— of nervous system	56	— retained	617
— nipple	406	— — Torek's operation for	618
— pharynx	56, 381	— syphilis of	625, 626
— primary	51	— tuberculous disease of	620, 627
— of rectum	56, 516	Tetanus	39
— secondary	52	— cephalo-	41
— skin lesions in	53, 55	— chronic	40
— tertiary	54	Thiersch's skin-grafting	27
— of testis	625	Thomas's splint for fractured femur ..	224, 225
— tongue	56, 372	— — for tuberculous hip	294
— tonsil	380	— walking caliper splint	224, 225
— treatment of	58	Thoracic duct, division of	155
— of viscera	56	— nerve, posterior, affections of ..	170
Syphilitic arthritis	280		

	PAGE		PAGE
Thorax, injuries and wounds of ..	397	Tonsillitis	378
— in rickets	244	Tonsils, affections of	378
Throat, cut	384	— hypertrophy of	379
— mucous membrane of, in syphilis ..	54	— new growths of	380
Thrombi, varieties of	147	— removal of	379
Thrombo-angitis obliterans	22	— syphilis of	380
— ganglionectomy in	176	Torek's operation for retained testis ..	617
Thrombosis, infective, of cerebral ..	330	Torsion of abdominal viscus	580
— sinuses	351	— penis	615
— — — of otitic origin	132	— spermatic cord	618
— symptoms of	147	Torticollis	186, 192
— venous	21, 22	— spasmodic	168
Thrombotic gangrene	370	Towels, sterilization of	93
Thrush	636, 638	Trachea, foreign bodies in	395
Thumb, amputation of	261	— s.m.	646
— dislocation of first phalanx	77, 373, 374	Transfusion of blood	125
Thyroglossal cysts	373	Transpyloric plane, s.m.	650
— duct tumours	644	Traumatic aneurysm	145
Thyroid artery, s.m.	646	— arteritis	134
— cartilage, s.m.	77	— cephalhydrocele	320
— extract in cancer	385	— dislocations	256
— gland, atrophy of	385	— epilepsy	336
— — diseases of (<i>see also</i> GOITRE) ..	386	— fever, septic	36
— hypertrophy of	393	— gangrene	20, 22
— — malignant disease of	646	— hæmorrhages in hæmophilia	130
— s.m.	390	— insanity	336
Thyroidectomy, partial, in goitre ..	393	— nephritis	553
— subtotal, in exophthalmic goitre ..	386, 393	— neurasthenia	305
Thyroiditis	237	— neuroma	69
Tibia, Brodie's abscess of	229	— orchitis	624
— fractures of	249	— osteomyelitis	239
— periosteal sarcoma of	61	— paraplegia	305
— syphilitic osteosclerosis of	664	— rupture of urethra	608
Tibial artery, s.m.	164	— stricture of urethra	612
Tic douloureux	167	— syncope	101
— facial	162	— ulcers	11
Tinel's sign	216, 219	Trendelenburg's operation for varicose ..	151
Todd's splint for Colles's fracture ..	158	— veins	262
Toe-nail, ingrowing	638, 639	— sign in congenital dislocation of hip ..	644
Toes, amputation of	199, 200	Trephine points, s.m.	50
— deformities of	369	Treponema pallidum	179
Tongue, affections of	373	Trichinosis	164
— angioma of	371	Trigeminal neuralgia	41
— black	369	Trismus, simple, diagnosis from tetanus ..	662
— congenital malformations of	77, 372	Trochanters, s.m.	11
— cysts of	371	— — of foot	16
— dyspeptic ulcers of	76, 373	Tropical abscess of liver	533
— epithelioma of	373	Trusses in hernia	483, 486
— fibroma of	370	Tubercle bacillus	9, 62
— herpes of	371	— histology of	62, 65
— herpetic ulcers of	369	Tubercular rash in syphilis	53
— hypertrophy of	369	Tuberculin	64
— inflammation of	369	Tuberculosis	62
— injuries of	371	— of ankle	298
— irritation ulcers of	370	— bladder	593
— leucoplakia of	373	— colon	505
— lipoma of	371	— diagnosis of	64
— mercurial ulcers of	373	— of elbow	288
— papilloma of	373	— hip	290
— sarcoma of	372	— — diagnosis from congenital dis- ..	263
— simple tumours of	369	— — location	291
— swallowing	56, 372	— joints, ankylosis due to	269, 270
— syphilis of	371	— — diagnosis from synovitis	557
— ulcers of	372	— kidneys	296
— tuberculous	369	— knee	
Tongue-tie			

	PAGE		PAGE
Tuberculosis of lip	353	Tumours of tonsil	380
— lungs	401	— vascular	151
— sacro-iliac joint	289	Turbinate bones, diseases of	367
— shoulder	288	Tympanites	458
— spine	311	Typhoid arthritis	274
— spleen	546		
— tarsal joints	298		
— testis	625, 627	ULCERATION	2, 11, 19
— treatment of	64	— in congenital syphilis	57
— of wrist	289	— intestinal stricture due to	474
Tuberculous abscess	6	— lupoid, in syphilis	55
— of spine	311	— stages of	13
— bursitis	183	Ulcerative colitis	499
— disease of bones	239, 252	Ulcers	2, 11
— joints	274	— atheromatous	135
— — diagnosis from synovitis	269	— classification of	11
— endarteritis	136	— of colon	500
— laryngitis	396	— congestive	14
— lymphadenitis	154	— duodenal	450
— myositis	179	— test meal in	436, 450
— periositis	240	— eczematous	14
— peritonitis	420	— following a burn	14
— prostatitis	601	— gastric (see GASTRIC ULCER)	
— tenosynovitis	182	— granular	47
— thyroiditis	386	— gummatous	55
— ulcers of tongue	372	— irritable	14
Tuberosities of humerus, s. m.	654	— of lips	353
Tubulo-cysts	78	— malignant	11
Tubulo-dermoids	77	— of bladder	592
— branchial	384	— of rectum	73
Tumours (see also under various		— necrotic	11
tumours)	67	— of nipple	406
— adrenal	72	— perforating	16
— of bladder	591	— pyogenic	11
— bone	248	— rodent	73, 74
— — causing fracture	201	— — of scalp	337
— breast	408	— specific	11
— cerebral and cerebellar	342	— syphilitic	12, 17, 53, 54, 55, 57
— connective-tissue	68	— of tongue	371
— due to protrusion of brain through		— traumatic	11
skull	341	— trophic	11
— epithelial	72	— — of foot	16
— innocent	67	— varicose	14, 17
— intracranial	342	— varieties of	11, 14
— of jaw	360	Ulna, fracture of	217
— kidney	566	Ulnar artery, s.m.	656
— larynx	397	— nerve, injuries of	171
— lip	354	— — s.m.	660
— lung and mediastinum	399	— styloid, s.m.	660
— malignant	67	Ulnar-humeral joint, s.m.	656
— of muscles	181	Umbilical hernia	487
— parathyroid, generalized osteitis		Undescended testicle	617
fibrosa and	247	Unna's paste	15
— penis	616	Ununited fractures	210
— pituitary	344	Urachal cysts	77
— of rectum and anus	516	Uræmic stage of calculous anuria	565
— renal pelvis	571	Urea concentration test	576
— sacro-coccygeal	311	Ureter, calculi in	574
— of salivary gland	372, 378	— congenital abnormalities of	547
— scalp	337	— injuries of	571
— skull	338	— obstruction by valves or stricture	573
— spinal cord	308	— operation wounds of	572
— spleen	546	— s.m.	654
— stomach	451	Ureteritis	573
— thyroglossal	373	Uretero-ureteral anastomosis	572
— of tongue and floor of mouth	372	Urethane injections in varicose veins	151

	PAGE		PAGE
Urethra, anatomy of	608	WARDROP'S operation for aneu-	
— rupture of	608	rysm	142
— stricture of	608	Warts	72, 157
— — complicating gonorrhœa ..	47	— gonorrhœal	47, 157
— — local complications of ..	613	— of lip	353
— — organic, treatment of ..	612	— venereal	47, 157
— — spasmodic and congestive ..	609	Wasp stings	83
— — traumatic	612	Wassermann's reaction	50
Urethral injections in gonorrhœa ..	46	Weaver's bottom	183
Urethritis, gonorrhœal	45	Web fingers	189
Urethroscopy in gonorrhœa	46	Wheelhouse's operation for urethral	
Urethrotomy in stricture	612	stricture	613
Urine, extravasation of	613	Whitehead's operation for cancer of	
— incontinence of	597	tongue	375
— retention of	598	— — piles	522
— — complicating gonorrhœa ..	47	Whitlow	32
— — in prostatic hypertrophy ..	604	Winnett Orr's treatment of fractures ..	270
Uterus, cancer of, radium treatment	76	— — — osteomyelitis	238
— — resection of presacral nerves in	177	Winslow, foramen of, hernia into ..	465
		Wire (Kirschner's) for skeletal traction	226, 227, 230
VACCINE therapy in gonorrhœa ..	49	Wiring of aneurysms	143
— — to produce resistance to		Woolsorters' disease	42
infection	90	Wounds (gen.)	80
Vaginal hydrocele	618	— of abdomen	416
— — primary chronic	620	— antiseptics for use in	94
Vagus nerve, affections of	167	— of blood-vessels	131
Varicocele	612	— contused	81
Varicose aneurysm	146	— of gall-bladder or ducts	525
— ulcers	14, 17	— gunshot	82
— veins	150	— healing of	84
Varix, aneurysmal	146	— of heart	402
Vaseline pack, closed, in osteomyelitis	238	— incised	80
Veins, diseases of	147	— of kidney	550
— varicose	150	— lacerated	81
Vena cava, s.m.	648, 654	— of liver	524
Venereal warts	47, 157	— lungs	397
Venous hæmorrhage	129	— pancreas	540
— thrombosis	147	— punctured	81
Ventral hernia	488	— of scalp	319
Ventriculography in diagnosis of hydro-		— skull	320
cephalus	340	— spleen	545
Verrall's splint for ulnar and median		— stomach	437
lesions	173, 174	— thorax	397
Vesical (see BLADDER)		— throat	384
Vesiculitis complicating gonorrhœa ..	48	— tongue	369
Viscera, syphilis of	56	— ureters	572
Vitello-intestinal duct, cysts of ..	78	Wrist, diseases of	289
Volkmann's contracture	180, 185	— dislocations of	261
Volvulus	466	— Madelung's deformity of	189
— caecal and colic	467	— s.m.	658
— enteric	467	Wrist-drop in musculospiral paralysis	170, 172
— sigmoid	466	Writing centre, motor	346
Vomiting in acute abdominal con-		Wry neck	186, 192
ditions	582	— — spasmodic	168
— after anæsthesia	109		
— in intestinal obstruction	458		
— intracranial tumours	342		
Von Bechterew's type of spondylitis			
deformans	318	X-RAY appearances of bone lesions	253
Von Gies' joints	280	— — diagnosis of gall-stones ..	531
Von Mikulicz' disease	378	— — hydrocephalus	340
Von Pirquet's cutaneous reaction ..	65	— — pyelography	556
Von Recklinghausen's disease ..	246	— examination of stomach ..	435, 441
Vulvo-vaginitis	48	— therapy in cancer	75

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